THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXVI.—No. 12. Whole No. 1,398. | NEW YORK, MONDAY, MARCH 24, 1902. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C. O. D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES—
- Fourth Annual Meeting, Southwestern Gas, Electric and Street Railway Association 405
- Wrinkle Department, Western Gas Association 405

EDITORIALS—
- Special Editorial Correspondence—18th Annual Meeting, Ohio Gas Light Association 405
- Briefly Told 406
  Obituary Note—Mr. William Cartwright—Notes.
- Proceedings, Thirty-second Annual Meeting, New England Association of Gas Engineers—Official Report—Revised by the Secretary —Continued from page 376 407
  Second Day, Feb. 20, Morning Session—*Some Details in the Operation of a Water Gas Plant, by Mr. Chas. F. Leonard—Discussion—Report from Committee on President's Address—Coal Gas Treatment, by Mr. A. B. Slater, Jr.
- *The Theory of the Incandescent Mantle, by Messrs. A. H. White, H. Russell and A. F. Traver 413
- Portland Cement and Coke Breeze 417
- The Metric System, by Mr. Godfrey L. Cabot 417
- An Experience in Canvassing, by Mr. F. W. Cross 418

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 419
Contract for the Western Gas Construction Company—A Circular from Secretary Stuart—The Iroquois Machine Company—Contracts for the U. G. I. Company—To Improve the Alexandria, Va., Works—Ditto, Kankakee, Ills.—No more Fuel Gas, Bridgeport, Conn.—Contract for Capt. W. H. White—A Tax Rate Decision—Rates that may be Charged for Gas and Electric Lighting, Vallejo, Cal.—New Gas Inspector, Kansas City, Mo.—Death of Col. Benjamin Brooke—Annual Meeting, Hudson County (N. J.) Gas Company—Cheaper Gas for Rochester, N. Y.—And Other Items.

- The Market for Gas Securities 421

[OFFICIAL NOTICE.]

Fourth Annual Meeting, Southwestern Gas, Electric and Street Railway Association.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION,
OFFICE OF THE SECRETARY,
WACO, TEX., Feb. 8th, 1902.

The Fourth Annual Meeting of the Southwestern Gas, Electric and Street Railway Association will be held in San Antonio, Tex., on the 18th to the 21st of April, 1902. As the membership is alive with interest, both on account of the place selected to meet and the good results to be obtained, a successful meeting is therefore assured. The headquarters and programme in detail will be announced later.

T. H. STUART, Sec'y.

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF WRINKLE DEPARTMENT.
BELLEVILLE, ILLS., February 12th, 1902.

This department is now open and ready for contributions, which will be presented at the Twenty-fifth Annual Meeting to be held next May. The active co-operation of all members and friends is earnestly solicited. Please forward contributions to the Editor before April 15th.

W. E. STEINWEDELL, Editor.

[Special Editorial Correspondence.]

Eighteenth Annual Meeting, Ohio Gas Light Association.

COLUMBUS, O., March 20, 1902.

According to programme and previous notice the Ohio Gas Light Association convened in the Great Southern Hotel, Columbus, O., at 10 A.M., of yesterday, under the most favorable auspices, to commence the work of its 18th annual convention. The weather conditions were good, the attendance was numerically and attentively the best in the records of the Association, the quarters on housing and meeting room accounts were all that could be desired. The officers were capable and alert, and right through the sessions, two of which were held (from 10 A.M. to 12:30 P.M.; and from 2 P.M. to 6 P.M.), there was that indefinable, but all pervading spirit of animation with go which marks a business gathering not bored by its work. The President, Mr. Henry L. Doherty, who the programme record says is of New York city, but who has been doing much good missionary work in the gas line in various parts of the country the past year or so, having cast an inquiring eye upon the Association's clever Secretary, Mr. T. C. Jones, of Delaware, O., called the meeting to order, without any particular ado. Mr. Doherty made an excellent presiding officer, for while the work was expedited nothing was slighted. Some routine business, in fact, much of it, was disposed of speedily and then came the Presidential address. I will offer no criticism of it in these dispatches, save to say that some of its passages are heavy with what may be thought revolutionary

LIBRARY OF CONGRESS MAR 24 1902

ideas. Notably is this so in the paragraphs which relate to "The Advantages of Dividing Association Work." In any event President Doherty had the satisfaction of knowing that the address was most attentively considered. The plan formulated by the Executive Committee this year that no formal papers be presented, but that instead written opinions on subjects named in advance should be sent in, such subjects and opinions thereon to be discussed in joint debate, worked exceedingly well. The discussion on the topic "Are Loose Leaf Ledgers Desirable for Gas Company Records?" for instance, brought out a rattling debate. The sentiment was decidedly in affirmative response to the question, especially in the instance of the value of cards as handy auxiliary records. As to "How may Complaints be Best Cared for?" the return postal card scheme, as explained in the contributed opinion, by Mr. Frank W. Frueauff, of the Denver (Col.) Company, excited much interest. The "Best Way to Extend Gas Mains," etc., two cleverly written opinions on which were respectively submitted by Mr. John Franklin, of Cincinnati, and Mr. B. W. Perkins, of South Bend, Ind., provoked a brisk discussion, in which several tellingly pointed speeches were made by Messrs. John R. Lynn, John D. McIlhenny, F. W. Stone, John Franklin and George Whysall. Editor Perkins had much reason for satisfaction over the way in which his "Novelty Advertising" budget was received. Many of the schemes reported were meritorious, and some of them should be labeled "novelties," beyond a doubt. The discussion on the "Equity, Legality and Advisability of Charging Different Rates for Illuminating and Fuel Gas," was decidedly on the forceful order, the main condiment to the argument being furnished by President Doherty, who invited Vice-President Andrews to wield the gavel while the President *de facto* from the floor maintained in the stoutest of terms, that differential rates were unassailable from any standpoint. There were those, however, wlio differed with him. A discussion on the particular or specific influence of gas gravity respecting the flow of gas through pipes, and a debate on Question No. 14, "What value should we place on our retort carbon?" furnished much interesting and instructive dialogue. The regular sessions for the day were fittingly brought to a close on the presentation, by Editor E. E. Eysenbach, of a most interesting collection of "Wrinkles." The alliteratively named gentleman well deserved the compliments that were showered upon him when his recital was at an end. The local Gas Companies had arranged an excursion to the Sugar Grove natural gas fields, but it was finally decided to abandon the scheme, and in place of that journey, the members were the guests of the Companies at a theater party, which was thoroughly enjoyed. Nothing has been left undone for our comfort that should have been done, and the general feeling in respect of the prospects of the industry as a whole is pretty well indicated by the tales that are told by the construction and supply men over construction contracts signed and in process of closing. —J.

COLUMBUS, O., March 21, 1902.

The weather continued fair and warm for the ending sessions of the meeting, the interest in which was maintained to the last. The first topic to engage the members the morning of the second day was the communication by Mr. F. H. Shelton on the "Distribution of Gas at High Pressure." In the absence of the author his lines were read by Mr. George H. Tayler. A brisk discussion, in which widely diverging views were advanced, was terminated by the appointment of a committee to investigate the subject and report conclusions thereon at the next meeting. Then followed an animated debate on the topic, "Recent Developments in By-Product Coke Ovens," the expressions of the speakers showing much difference of opinion regarding the status of the question. A topic not on the regular programme, contributed by Mr. D. R. Russell, of St. Louis, respecting the relative merits of half and full-depth furnaces, was read and discussed. Mr. Russell handled his subject well, and the general tenor of the arguments favored the full-depth practice. The matter of "Isolated Generator Firing of Benches," next occupied the attention of the Association, and the conclusion of the discussion virtually ended the morning session. At 2 o'clock the regular order was resumed. Cincinnati having been named as the next place for meeting, the report of the Committee on President's Address was taken up. It contained many recommendations, notably those relating to the publication of the "Proceedings" of the Association. The Committee on Memorials having submitted appropriate minutes respecting deceased members, the members addresed themselves to debating the question "Can Iron Meter Connections be Used to better Advantage than Lead?" The lead advocates seemed to preponderate. "Recent Developments in Inclined Retorts," was then taken up. Neither of the writers who prepared set paragraphs on the subject (Mr. F. Egner and Mr. A. H. Barret) was present, but their communications were listened to with much interest. The topic of "Domestic Water Heaters" was discussed prior to the inclined retort communication. The officers elected were:

President.—C. W. Andrews, Hamilton, O.
Vice-President.—John D. McIlhenny, Phila., Pa.
Secretary and Treasurer.—T. C. Jones, Delaware, O.
Executive Committee.—H. L. Doherty, F. W. Stone, Fred. Persons, Jno. Franklin and C. A. Schwarm.
Editor Wrinkle Dept.—E. E. Eysenbach, Columbus, O.
Editor Novelty Advertising Dept.—B. W. Perkins, South Bend, Ind.

The meeting was an unqualified success, and officers and hosts were unremitting in their well practiced and well timed efforts to keep up the good work "in and out of meeting."—J.

BRIEFLY TOLD.

OBITUARY NOTE.—MR. WILLIAM CARTWRIGHT.—In our issue for last week we announced the death of Mr. William Cartwright, who for almost 50 years had been honorably and prominently identified with the gas industry of this country. Since that mention was made we have received the following authentic sketch of his life, for the main particulars of which we are indebted to the attention of Mr. H. R. Cartwright, of Philadelphia. Mr. William Cartwright was born in Philadelphia, Pa., April 16th, 1822. He was the oldest of five brothers, all of whom were engaged in the gas industry as constructors, engineers or superintendents. Having acquired a soundly based knowledge of mechanical engineering, in 1853 he made his first venture in the gas field, in which year he undertook the supervision of the construction of the gas plant at Geneva, N. Y. In 1854 he went to Waterbury, Conn., there to conduct the building of the Waterbury gas works. He was the first superintendent of the works of the Washington (D. C.) Gas Company, and was also concerued in the construction of the Catasauqua (Pa.) bridge, which was built under the direction of a famous engineer in his time—a Mr. Lowthrop. In 1859 Mr. Cartwright accepted the position of Engineer and Manager of the gas works at Oswego, N. Y., which place he retained until late in 1889. Under his management the Company thrived, and during his stewardship the works were completely rebuilt. In 1890 he was elected President of the Northern Liberties Gas Company, of Philadelphia, and served it in that capacity until 1893. Since then he was not actively engaged in business, fully cognizant of the fact that long and faithful service well entitled him to the rest that should follow two score years of successful work. He was an original member of the American Gas Light Association, and in its early days his counsel was of much value to it. His was a personality of rigid honesty, and that which he considered right was persistently maintained by him. All who came in contact with him respected him for his frankness and his sincere desire to do only that which was honorable and right, even though such practice might not be to his personal gain. A connection of 49 years with the gas industry naturally made him acquainted with many in the profession, and it is a simple expression of the truth to say that all who knew him respected him.

NOTES.—Mr. William L. Elkins, Jr., died at his home near Elkins Station, Pa., the morning of the 14th inst. He was in his 38th year. Deceased was prominently identified with the gas industry, having large proprietary interests in the South Jersey Gas, Electric and Traction Company, the McKeesport (Pa.) Gas Improvement Company, the Pittsburg (Pa.) Gas and Coke Company, the United Coke and Gas Company, and the New England Gas and Coke Company. He was a member of the American Gas Light Assoeiation.——The proprietors of the Boise (Idaho) Gas Company declare they will construct a gas plant there this spring. The officers are: President, B. F. Olden; Vice-President, George W. Baker; Treasurer, N. P. Ustick; Secretary, William Simons.——The gas plant at Carlinville, Ills., is to be reconstructed. ——At the annual meeting of the shareholders of the Western Gas Company, of Milwaukee, Wis., no change was made in the executive management.——The sale of the properties of the Huntsville (Ala.) Gas Light Company, which was positively set for March 14th, was again postponed by Receiver Hundley, who now names March 27th as the date. Several bidders were present, but none of them would offer the upset price of $48,000. Much discontentment, and properly so, was shown by those who had made long journeys to participate in the bidding.——At the annual meeting of the Hamilton (Ont.) Gas Light Company the usual dividend was declared, and the following officers were elected: President, F. W. Gates; Vice-President, Edward Martin; Superintendent, Edmond Cathels.——The Amesbury and Salisbury (Mass.) Gas Company will commence forthwith the construction of a distributing main to Salisbury Beach, an outlying summer resort.

OFFICIAL REPORT.—REVISED BY THE SECRETARY.—Continued from Page 376.

PROCEEDINGS, THIRTY-SECOND ANNUAL MEETING, NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

HELD AT THE PARKER HOUSE, BOSTON, FEB. 19 AND 20, 1902.

SECOND DAY, FEB. 20, MORNING SESSION.

The sessions of the second day were commenced pursuant to the order for adjournment. The President introduced Mr. Charles F. Leonard, of Fall River, Mass., who read the following paper on

SOME DETAILS IN THE OPERATION OF A WATER GAS PLANT.

It is the aim of this paper to bring together a few points, which have appealed to the writer in a comparatively brief experience in charge of a gas works using the Lowe process.

In the double superheater type of Lowe water gas apparatus, oil is generally introduced at the top of the carburetor where it meets the water gas made in the generator, and passes with it down the carburetor, up the superheater and out through the take-off pipe to the wash box. The purpose of the carburetor and superheater, filled with a checker work of firebrick, is to break up this oil so that it will give the highest possible illuminating value to the water gas per gallon of oil used. To do this the checker work must have the right gradation of heat throughout its entire course, and this gradation depends on the kind of oil used.

When two bodies, one hot and the other cold, are in contact, heat will flow from the hotter to the colder one, but the rapidity of this flow or the rate of conduction varies approximately as the difference in temperature between the two. During a run heat is flowing from the bricks all the while, until the gas leaves the top of the superheater, but the rate at which the heat is flowing is greatest at the top of the carburetor, and gradually diminishes. In the Lowe process, water gas is being generated at the same time that the oil is introduced into the carburetor, and, meeting the oil, forms a gaseous envelope about it, and protects it from overheating all through its course through the machine. Even with this envelope, if the heats are too high, lampblack, and if too low, tar, will be formed in the gas above the normal amounts, and these detract from the efficiency of the oil as an enricher.

There is apparently an ideal gradation of temperature which will break up the oil just enough. Oil should not be subjected to the same heat twice, because if a hydrocarbon series is exposed to a higher heat than necessary it is damaged. The longer the run the greater is the drop in temperature through all the bricks. This would indicate that the shorter the run the less this ideal gradation in temperature is varied from. The practical application of this is that if runs of certain length are being used, and after each run the carburetor and superheater are comparatively black, it may be well to try shorter runs.

The common method of judging heats is by the naked eye, but recently an instrument, known as a blue glass pyrometer, has come into use which is a decided help. This instrument was described in a paper read by Mr. E. A. Earnshaw, at the Denver meeting of the American Gas Light Association in 1900.[1]

Our gas machines in Fall River are of the double superheater type. We are now using gas oil and anthracite coal; size, broken. On a fresh machine we use a certain combination of heats as expressed by the pyrometer, and as the machine grows older we raise the heats. The reason for raising them is that, as the machine gets dirty, the carbon deposits in the bricks incandesce and hide to a certain extent the real heat of the bricks, so that if the same number of blue glasses were depended upon as in a fresh machine the checkers would not really be as hot as indicated. Experiment alone can determine what is the best combination to use on a given machine. For several months of 1901 we found an average increase in oil efficiency—that is, a higher candle power per gallon—of about 10 per cent. over the corresponding months of the previous year, which was partly due to a closer approximation to the proper heats, made more easy by the use of the pyrometer.

If the oil spray is so set as to inject the oil into the center of the carburetor, the heat to vaporize the oil is absorbed from the middle bricks, and at the end of a run the carburetor is streaked. That is, the bricks near the circumference are hotter than the ones in the center, which look comparatively black; and, vice versa, if the oil is sprayed toward the circumference, at the end of a run the center bricks are hotter than the outer ones. The oil spray should be so regulated as to throw the oil evenly over the cross sectional area of the carburetor, and at times the spray requires to be manipulated more or less at different runs to secure this.

The height of the bricks in the superheater is a mooted point. We bring ours now to the top of the top manhole, although in the past we have kept them lower by a couple of feet. The advantage of bringing them up is that through the top sight-cock of the superheater the checkers can be seen and heats judged better than when kept down and the interior lining of the superheater alone is visible.

The extra bricks in the top of the superheater may give slightly better results in the hands of a skillful operator, while it is probably better to leave them out with one of limited experience. If the bricks are kept down too low in the superheater the gas has a tendency to drop its candle power on the street. The spacing of the bricks admits of variation. In our carburetor the spacing is 2 inches, the bricks being 9 inches by 2½ inches by 2½ inches in size. In the superheater the spacing is 1½ inches, the size of the bricks being 9 inches by 2½ inches by 4½ inches.

If the superheater, particularly at the top, gets too hot, it is not always easy by the manipulation of the blast valves to get it down. The cooling can be quickly done by having a steam pipe about 1 inch in diameter tapped into the connection between the carburetor and the superheater, and also one about half way up the superheater and allow the steam to blow in while on blast. This brings the heat down quickly, although if the steam is allowed to remain on too long the superheater may be cooled too much. Too high heat in the superheater spoils oil results, and the introduction of steam when necessary saves time and oil, and assists greatly in maintaining uniform candle power.

Length of blow depends on the condition of the fire, heats required and blast pressure used. With a high blast pressure there is a tendency for the superheater to get too hot, even when the carburetor blast valve is open and the superheater blast valve closed, the high pressure apparently driving the combustion over into the superheater before it has had a chance to take place in the carburetor to the extent that it ought. To remedy this it may be more desirable to cut down the opening of the generator blast valve rather than diminish the speed of the engine. If the speed of the engine is diminished the total amount of air delivered to the generator, carburetor and superheater is cut down, whereas if the generator blast valve is only partially opened the amount of air going into the generator alone is reduced.

Heats can be raised to a desired point under a high blast pressure quicker than under a low one, but while the heats may be up, the fire may not be hot enough to give a good-sized run, in which case it is necessary to shut down the carburetor and superheater blast valves, and allow the generator blast gases to blow through the machine and up the stack. That is to say, if 7 minutes is the usual length of blow, and the heats are high enough in 5 minutes, it may be necessary to blow 2 minutes longer to get the fire hot enough. This is a waste of coal for 2 minutes. Our practice is to go on the run as soon as the heats are up in the carburetor and superheater, but we find it necessary at times to blow a little longer as just indicated.

The differential gauge which indicates the difference in blast pressure between the top and the bottom of the fire is a convenient index of the condition of the fire. We usually run 9 inches, but there is a tendency to cut this still lower to 5 and 6 inches, particularly where short runs are made, as when coke is used for fuel. With a high blast head we find a fire will give larger runs than with a low one, but the make will drop faster and there will be a wider variation between the size of the first runs just after cleaning and the last ones just before running down to clean again. While a low pressure head gives smaller runs, the make is evener and the fire lasts longer before requiring to be cleaned.

As has previously been said, the fire must be at the right temperature when putting on a run. It is a question here between a deep and a shallow fire. The deeper fire seems to have the advantage, because it gives a larger make per hour, and also because a higher percentage of the steam supplied to it is decomposed than in a shallow one, which means less boiler fuel.

On starting up after cleaning a fire the make is at a maximum and gradually diminishes until cleaning time again. The curves in Fig. 1 give an idea of how the make drops under our conditions during the period of about 12 hours from the time of cleaning until the fire is run out. These 4 curves were plotted from data on 4 different days. The blast pressure at the bottom of the generator was 16 inches. The relief holder and station meter were read at the end of each 4 runs and the make per run computed. The makes indicated can only be taken relatively, as the temperature of the station meter was about 80° F. The first 4 runs are abnormally high, as the exhauster was not started until the relief holder had partially filled, it being almost empty at the

1. See JOURNAL, Nov. 19, 1900; p. 802.

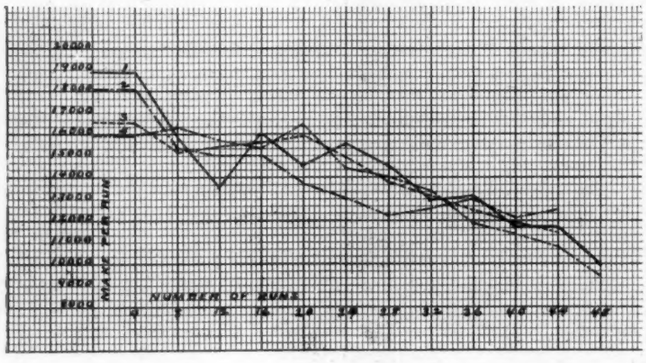


Fig. 1.

end of the first run. They do bring out the point, however, that there is a very material drop in the size of the run as the fire grows older, and that it is necessary to cut down the number of gallons of oil used per run with the make to get oil results. While running one machine it is a comparatively easy matter to find out how fast to cut the oil, by taking the station meter reading and the height of relief holder, say every 4 runs, and figuring up the oil per 1,000. The candle power of the relief holder taken at the same periods will show whether the oil is being reduced too fast.

The frequency of coaling depends on the size of the apparatus and fuel used. In an 8 feet 6 inches set we put in 1,200 pounds of anthracite each 4 runs, the runs being 8 minutes long. Twelve hours is generally the length of time a fire is run. When it is necessary to run 14 or 15 hours, instead of making a full clean at the end of 12 hours, then starting up and letting the fire lie over until next day, we make a small clean; that is, rake out at the stoke holes a little and slice the fire slightly at the grate, but do not attempt to clinker other than to settle the fire. This is merely a device to get over a few hours when the extra time needed does not justify a full clean. If for any reason the steam does not pass evenly through the fire, but instead passes up one side, a black spot will appear much sooner than it otherwise would and the make becomes so low as to make it advisable to clean. One advantage we have found in using an up run and a down run alternately instead of 2 up runs and 1 down run is that a fire will last longer.

Two minutes before the end of a run the oil is shut off to allow the machine to purge itself, and one-half minute before the end of a down run we change over and reverse the steam.

The length of time required to clean fire depends on how hard the clinker is and the number of men put on it. If it is fairly soft with 4 men it takes on our machines about 70 minutes; sometimes less and sometimes more.

In starting up a machine after it has been shut down, it is difficult at times to get up candle power right away. One way to help matters is to have a steam connection running to the bottom of the wash box, and one each to the inlets of scrubber and condenser, and heat up all 3 before starting. The gas first made is thus not suddenly cooled and required to give up its sensible heat to the wash box, scrubber and condenser, which would have a bad effect on the candle power.

The oil used per 1,000 and the candle power results obtained indicate at once whether the machine is doing good work or not. If it is not, there are several places to look for trouble. The overflow from the scrubber can be looked at for either carbon or tar, which means too high or too low heats, respectively. If during a run the gas is allowed to blow out of the sight-cocks, the color of it is a rough indicator; at the bottom sight-cock of the carburetor it is a bluish color; at the bottom sight-cock of the superheater, a bluish brown, and at the top sight-cock of the superheater a still darker shade of brown. By trying the colors when a machine is doing well a rough standard can be obtained by which to judge when results are poor.

In case of trouble the carbon dioxide test is a good place to look to. Too much or too little steam quickly results in poor work. The rule generally given is to admit enough steam during a run to get 3 per cent. carbon dioxide in the finished gas, but no more. In 1899, at a meeting of the American Gas Light Association, Mr. A. G. Glasgow[1] stated that each per cent. of carbonic acid in illuminating gas is equivalent to the loss of about $\frac{2}{3}$ of a candle in the illuminating power of the gas. This approximate figure was determined in many different places by very comprehensive tests.

1. "Carburetted Water Gas as a Coal Gas Auxiliary;" JOURNAL, Nov. 13, 1899; p. 766.

A method of determining quickly the candle power in the relief holder with a fair degree of accuracy is a great help in running. We use a 60-inch bar with an Edgerton standard fitted up on the generator floor, the operator making a test once an hour.

The periodical blasting of the carburetor and superheater, the blast not being on the generator, helps to keep the machine clean. The carbon on the bricks unites with the air and burns going up the stack. If a machine has been acting badly, and there is evidence that carbon has been deposited to a high degree, it may pay to blast immediately. This may leave the superheater too hot to make gas efficiently right away, and it will have to be allowed to cool down by letting the machine stand idle, or else cool down with steam, if necessary to start the machine at once. The best time to do it is just after the fire has been run down, and the machine is to be idle for several hours.

If a machine is run carefully the take-off pipe ought not to clog with carbon. We find enough, however, to warrant cleaning once in 3 weeks, when the machine is being run continuously.

The length of time a machine can be run without renewing bricks depends on whether the drop in oil results is more than counterbalanced by the cost of renewal. We run ours on about an average of 3 months of 24-hour days. In a large output the cost of cleaning the bricks is a comparatively small item beside poor oil results, and it pays to err on the side of cleaning out too often rather than the reverse.

In renewing checkers, steel brushes are used to clean off the dirt, replacing all that do not crumble and are in fair condition, and putting new ones in the carburetor at the top and in the superheater at the bottom, as they absorb heat better than the older ones.

The stoke hole castings have to be renewed occasionally, because the fire falling down at cleaning time burns them. Firebricks shoved in to push the hot coals back save the castings, but if not attended to at every cleaning the castings burn off eventually, the firebricks above them crumble, and allow the fire to get against the shell, and it may be necessary to shut down the machine even before the condition of the checkerbricks warrants.

All valves need to be looked to frequently; both stuffing boxes and seats. For instance, if the up run steam valve leaks during a blow it tends to cool off the fire and defeat the very purpose of the blow,

The Bristol recording pressure gauge, besides showing at a glance the blows, runs, coalings and shut-downs, is also a permanent record of the blast pressure, and also the pressures of the machine while making.

A large number of different factors enter into the operation of a water gas machine, some of which are coal, oil, blast, heats, condition of firebrick, and a multitude of small but important things, which afford opportunity for a wide range of difference of opinion and practice, and a very fertile field for investigation.

Discussion.

The President—Gentlemen, the paper is before you for discussion. We would like to hear from Mr. J. J. Humphreys, Jr., of Worcester.

Mr. J. J. Humphreys, Jr.—I should like to know what Mr. Leonard means when he says that oil should not be subjected to the same temperature twice. I presume he means in relation to that gradation of temperature which is ideal and which we don't get. Also Mr. Leonard seems to have a spray that will throw towards the center or towards the outer edge. I would like to know the kind of spray that he uses. He gives the time during which this set runs without clogging up, but that does not seem to be in a way that we can understand. It would seem better if he would tell us how much gas he makes without removing his checkerbrick. He says in the high blast there is a tendency for the superheater to get too hot, even when the carburetor blast valve is open, and that it fairly blows the heat over. Perhaps that water gas set does not have as much air as they could use on the carburetor. Has he one or two blast pipes on his carburetor. The chart shows at the beginning of the day, for the first 4 runs, an average on one of his tests of 19,000, running down at the end of 12 hours to 10,000. I should like to ask him if he has considered whether the economy of the set is not just as good making his runs more per run but less runs per 12 hours, by cleaning oftener, and keeping his fire in more nearly average condition. Also, he seems to have some trouble with starting a new set as to low candle power, but that I think is a matter of treatment, and that he will probably find with low enough heats he can start a new set just the same as a set that had been running for months. I would like to know if the gas oil has say 30 per cent. of heavy oils, and if he is running to save his light oils in it how he can tell when he is making too much tar by his eye from the wash pots. I also want to know how that operator who is part of the time on the floor makes his test once an hour; whether he stops run-

ning for 5 minutes or just makes a quick 1-minute test, which is not quite so accurate.

Mr. Leonard—Regarding Mr. Humphreys' question as to why oil should not be subjected to the same heat twice, we carry our heats the highest at the top of the carburetor and gradually diminish them down the carburetor and up the superheater, and, as I understand it, if we break up oil, when we first break it up, certain series of hydrocarbons are formed which should be subjected to gradually diminishing heat. If you overheat them they are going to be broken up too much. We use a Collins oil spray. We find that if we get it set just right it will spray evenly over the carburetor, but at times we do find a streak towards the circumference and sometimes in the center, so that the gas maker has to manipulate it at different runs and is able thereby to keep the heat even.

Mr. J. J. Humphreys, Jr.—What I want to know is whether you use a hollow cone spray, or a spray in which the jets supposedly dash against each other, but that when one jet stops the others all cross.

Mr. Leonard—We use a hollow spray. There is also a small, round valve having 4 holes in it, and you open and close that. It throws the oil to the outside from the center. Regarding how much gas is made without renewing the checkerwork checkers. We have an ordinary 8-foot 6-inch set. When I say that we renew the checkers on an average about once in 3 months, that is only an approximate figure; sometimes we do it oftener, sometimes not so often, but on the average, supposing that we are running ordinarily as the curves would indicate, starting with that make per run and running down the scale, we run 3 months with a 24-hour day, and we think it is about time to renew. But sometimes,if we have bad luck, we have to clean oftener, and sometimes we don't do it so often, particularly in the summer time. I have no figures as to the make of gas; at least, I don't remember how much gas we make when we have to renew. We have one blast pipe going to the carburetor. Regarding the combustion being thrown over into the superheater under high blast pressure, we have found sometimes that when using the high blast pressure the top of the superheater gets too high and by manipulating the blast valves we are not able to get it down. By lowering the blast pressure that difficulty is overcome to a certain extent. As to low candle power at the starting up of a new set, what I meant was that in the morning, if you stopped say the night previous at 6, 7 or 8 o'clock, and the machine had a chance to cool down, when you start the machine making gas into the relief holder the candle power is apt to be low, so that we put steam into the wash box, condenser and scrubber and heat them up, so that the gas first coming over would not have to give up its heat to heat the water and those chambers, and we find it a slight benefit. That test of the tar in the seal pot, as to whether you are running too high or too low heats, is only an approximate one. Sometimes if you are running very high heats you will have chunks of carbon in the seal pot, and if you are running too low altogether you will have tar on the surface of the seal pot; but it is merely a rough indication. Concerning the test of the candle power on the generating floor by the gas maker, the Edgerton standard lends itself to a very quick test, and when it is regulated it does not take more than 1 or 2 minutes to take a test, so that in from 6 to 7 or 8-minute blows and 8-minute runs it is a comparatively easy matter for the gas maker to find time to take a test. Have I answered Mr. Humphreys' questions?

Mr. J. J. Humphreys, Jr.—One that Mr. Leonard has not answered, is why is it not just as economical to make runs throughout the day more nearly average by cleaning a little oftener, instead of making 19,000 at the beginning, when the set is in its best condition, and 10,000 at its worst?

Mr. Leonard—Well, I think that probably where you clean oftener the coal per 1,000 is apt to be a little higher, and if you are able to measure your make per run and how fast it is falling you are able to cut your oil, and you get about as good oil results when the make is low as when you first start up and it is high. So that the advantage of running as long as you can is that it takes less labor to clean, and I think you get a little better coal results; and also, where we are running sometimes, as we do, full, we don't want to make more than 2 cleans a day if we can help it. That is, when running 24 hours the fire would be cleaned once in 12 hours. In the summer time we probably will run 12 hours, say, or a little more, before cleaning. That length of running lends itself to easier working with regard to cleaning fire and labor.

The President—Mr. Africa, we would like to hear from you.

Mr. Africa—I think Mr. Leonard has covered the work very well. I would like to ask him how much candle power per gallon does he get? I ask this question in order to show to the members that this method of running will produce good results.

Mr. Leonard—The candle power per gallon of oil used will vary considerably in the summer time. I think our best results are something like 6.33. In winter time they drop considerably.

The President—Is that gross or net? Do you figure out the tar?

Mr. Leonard—No.

The President—Then it is gross.

Mr. Leonard—That is to say, you take the number of gallons of oil used and divide it by the make corrected, and divide the average candle power by that.

The President—Yes.

Mr. Leonard—Corrected to 60° and 30 inches.

Mr. Africa—I would say that we run in about the same manner, and the oil results in summer are practically the same; in the winter it drops down to between 5 and 6 candles to the gallon.

The Secretary—Does Mr. Africa use the steam connection on top of his superheater?

Mr. Africa—No. We removed about half the brick in the superheater, so that we do not get too much heat in it. It answers the same purpose as cooling down what brick you have there. We have an old style apparatus, and the superheater is about 30 feet high, so we had too many brick for the size of balance of the apparatus. By reducing the number we finally got the right proportion of brick, so that the whole apparatus gets the right heat at the same time. When we finish the blowing, the fire, carburetor and superheater are all in the proper condition, so that we do not need to use the steam; but I should think it would be a very good idea to have that connection.

Mr. Addicks—I should like to ask Mr. Africa, first, whether he uses a relief holder; second, what his average candle power is?

Mr. Africa—We use a relief holder. The average candle power is from 26 to 28.

Mr. Barnum—What does Mr. Africa use in testing the candle power?

Mr. Africa—An ordinary 8-foot lava tip.

Mr. Addicks—I should like to ask, to make it complete, first, as to whether the bar is at the works or a mile or more therefrom, and whether the test is taken at both of such locations?

Mr. Africa—The bar photometer is at the works. We also have a bar at the office; which is 1½ miles away; but as we make a mixed gas the candle power taken at the office uptown would not affect the water gas results. The candle power is taken a number of times a day with a pentane standard lamp.

Mr. McKay—Mr. President, this paper of Mr. Leonard's is a thoroughly practical one, full of sensible observations very concisely stated. It ought to be of a great deal of help to people who are taking up this work, and the last bulwarks that have been opposed to water gas in New England are falling fast. I was surprised, however, to learn that in making gas with the double superheater apparatus Mr. Leonard finds that the highest heat is at the top of the carburetor, and that he subjects the oil vapors and water gas to a constantly diminishing heat. We certainly don't have the highest heat at the top of the carburetor. Taking the heat at the top of the carburetor as one condition, the bottom of the carburetor is hotter than that, the bottom of the superheater is hotter than the bottom of the carburetor; part way up the superheater is the hottest of all; perhaps one-third the way up the superheater. To overcome the difficulty he mentioned, about laying up the brick in the top of the superheater so as to use a sight-cock to tell the heats, we put in another sight-cock about 4 feet lower down, so that we can tell the condition of the heat at that point, no matter how the bricks are laid. We found it was desirble to cease the checkerwork where the dome of the superheater begins to come in, so that the gas should be subjected to no restriction while it was taking up this large amount of heat. One thing to be considered with respect to feeding oil in on the carburetor, especially where the top of the carburetor is the hottest in the apparatus, is the temperature of the oil as it flows in. If there is a very large difference in temperature between that oil and the bricks, it would seem as though it must affect the decomposition of the oil unfavorably. Perhaps Mr. Leonard can tell us at about what temperature the oil enters the carburetor. And with respect to the take-off pipe from this apparatus, which he mentions as not clogging up, I would like to know what the diameter of it is, and what amount in cross section is used up by the oil heater pipe that he uses. In other words, how much net free outlet from the machine is there, and what is the back pressure from his relief helder? I notice he tests the gas taken from the relief holder on a bar photometer in the generating room. As I understand it, that gas has not been thoroughly condensed, perhaps has not been scrubbed at all; it probably carries a reasonable amount of tarry vapors that are later thrown down. The test is made on an Edgerton standard, the chimney of which must suffer more or less from condensation of water vapor, and as it is in the generator house there must be a

deposition of ash, which would impair the relation of those tests to a bar photometer. I notice he still uses the soap brick in the carburetor. As the soap brick per volume of material is much more expensive than the ordinary square brick, I wonder if Mr. Leonard can tell us whether the advantage in the continued use of the soap brick repays him for the advance in price he has to pay for that form of brick. He speaks of getting down heats in the superheater by the use of two 1-inch steam pipes. Are those wide open when in use, and what pressure is the steam under that is admitted to the apparatus, and how long a time does he ever have to use those? It seems an enormous volume of steam if it is allowed to go in freely. We formerly used steam for a little while, but in a very small amount, in bottom of superheater while on blast, as we found that with gas oil the heats were raised quite high by the combustion of some of the residue from the gas oil. We found, however, that it was easier to regulate the heat by the time of the blow and run. By varying that we reached a point where the combustion of this oil residue from the gas oil would leave the apparatus (when ready to make gas) at just a right heat, so that we lost no steam and wasted no blast. He speaks of cutting down the opening of the generator blast valve. Our experience with that method of regulating the blast was less satisfactory than it was to leave the generator blast always full open, and to vary the pressure of the air in the main blast pipes. Referring to Fig. 1 there is a very large decrease in the make per run, from something like 18,000 down to 10,000. Perhaps one reason for the rapid decrease in the make is in the condition of the material in the generator. He speaks of the runs being 8-minute runs where he is heating 1,200 pounds of anthracite coal each 4 runs. How long are the blows corresponding to that? Are they variable, or are they a fixed time? This use of an up-and-down run we found left the apparatus somewhat too cold. In fact, there are a number of points through the paper that seem to indicate that the fixing surface is large for the gas made on the generator, and this up-and-down run would keep down the make on the generator thereby making that fixing surface relatively even greater. With respect to the 70 minutes for cleaning the fire, does that mean from the time the set is shut down till it begins to make gas again, or does it cover the time of pulling out ashes and coaling up? I don't exactly see why the candle power suffers when the set starts up after lying idle for a while. Certainly if the set is in the right condition for making gas, the gas leaving the apparatus ought to be just the same then as at any other time, and if it is chilled or cooled I can't see why it suffers more at this time than at another, if it is always a fixed gas. With respect to brushing the bricks taken from the fixing chambers: Is that which is brushed off ash, dry carbon, or other material? Does it pay to put back any old brick? The paragraph with respect to the valves on the apparatus might invite the comment that particular attention should be paid to the water cooled, hot valves. If these are not kept tight the advantage of the up-and-down steam service is less; they should be kept tight and frequently examined to remove the ash, and to see if the disks set tightly against the faces. Such an examination, while involving a little expense, amply repays for the work in the extra service that the generator will give.

Mr. Leonard—The take-off pipe, as I remember it, is about 16 inches in diameter, and the oil heater is made up of 4 lengths of extra heavy 1-inch pipe. I have not the temperature of the oil as it comes from the heater, but if you put your hand on the outside of the oil pipe it would be altogether too hot to leave it there. The back pressure of the relief holder is about 4 inches. Regarding the taking of the candle power on the Edgerton standard. It is quite hot on the floor in the summer time; the temperature will run up to 80°, possibly a little higher, and of course that will vitiate candle power results; but in order to overcome that we also take the candle power on the outlet of the main holder every hour with an Edgerton standard, so that the candle power as taken on the floor is merely a convenient index of the gas that we are making to enable the gas maker to tell whether to increase the oil or diminish it in order to keep the candle power in the large holder steady. In regard to renewing the bricks in the carburetor and superheater, I have no figures as to the relative cost of the soap brick; in fact, we use soap brick in the carburetor and the larger brick in the superheater. As to putting the steam to cool down the carburetor and superheater, it is done usually, when we have to do it, say once in 3 or 4 runs, and we leave the steam on for possibly 3 or 4 minutes during the blow. Sometimes we have to use it at both the bottom of the superheater and at the middle, but usually at the middle of the superheater is enough.

Mr. McKay—A 1-inch pipe, wide open?

Mr. Leonard—Yes.

Mr. McKay—What pressure of steam?

Mr. Leonard—About 100 pounds. I might modify that by saying sometimes it is wide open and sometimes not, depending on how high it is. If the superheater gets too hot and we want to get it down quick we let it wide open. The gas maker uses his judgment about that. In regard to blowing, we use 8-minute runs and the blow is variable; that is to say, sometimes it might be 6 minutes and sometimes 7 or 9; possibly 10, occasionally. We try, however, to make them as uniform as possible, usually about 7 minutes. As to the time required to clean, 70 minutes is the time required from the time of starting to the time of beginning to blast again; it is not the time up to the time at which we begin to make gas again. But the first blow generally occupies, at different times in the year, from 15 to 25 minutes. In regard to the question of dropping the candle power when we start up after a machine has lain idle for several hours, sometimes we find that it is a little bit difficult in starting up to get candle power immediately, and this heating of the apparatus helps a little. Why that should be so I have not investigated very thoroughly. In brushing off the bricks we use steel wire brushes, and we also use a steel scraper made of an ordinary file, say ¾ of an inch wide, sharpened at the ends. The steel wire brush takes off the loose ash, which is not stuck very hard to the brick, and then the steel scraper takes off an incrustation of carbon. As to whether or not it pays to put the bricks back, I can only say we do it.

Mr. Anderson—Mr. President, I should like to ask, in relation to the blower pressure on the set, what Mr. Leonard considers that should be; whether it should be 12 or 16 on a clean set. I am speaking of a set that is apparently clean and new.

Mr. Leonard—Well, I think the best way to judge the pressure on a set is by the differential gauge. We use 16 inches at the bottom of the generator, and the differential gauge shows from 8 to 9 inches, but I think there is a tendency to get down to 5 and 6 differential gauge, and better results are claimed. But we tried it and went back to a 9-inch differential, because we got a bigger make and the men were more used to it.

The Secretary—I would like to ask Mr. McKay if he referred to a Lowe set of the double superheater type in his remarks, in regard to the heats.

Mr. McKay—Yes.

The Secretary—And I would like to ask if either Mr. McKay or Mr. Leonard can tell me the effect on the amount of combustible gas from the generator in the blow by the variation of blast pressure on the generator; that is, how varying the blast pressure affects the amount of combustible gas which is available for heating the brickwork.

Mr. Leonard—You mean if you open the generator valve wide rather than partially open it?

The Secretary—Yes; of course that in effect increases the pressure within limits.

Mr. Leonard—If the generator blast valve is open wide, under your normal blast pressure you will get a certain volume of blast gases going up through the top of the generator. Now, if you diminish the opening of the generator blast valve that volume is diminished; how much I don't know. Cutting down the opening of the generator blast valve has about the same effect, I should suppose, as reducing the blast pressure on the engine. But if you are running 2 or 3 machines together it might be desirable not to diminish the total volume of the air going to the sets, and the suggestion in the paper, that it might be well to cut down the opening of the generator blast valve rather than cut down the speed of the engine, was merely a suggestion that it could be done that way where you have more than one machine in operation at the same time.

Mr. McKay—With a fixed opening in the generator for the blast, an increase in the blast pressure will have one of two results. 1st. If the air supply to the carburetor and superheater is changed so that the gases from the generator are burned in the fixing chambers, the heats will rise. 2d. If the air supply to carburetor and superheater remains fixed the increased blast pressure will carry more combustible gases from the generator into the atmosphere. There is another condition sometimes found; increasing the air supply to carburetor and superheater beyond the amount needed for combustion cools off one or both of these fixing chambers.

The Secretary—Mr. President, I think the gentleman did not quite grasp my meaning. I want to get at the amount of combustible gas coming from the generator with a high blast or a low blast.

Mr. McKay—It would be much more with the high blast. If you open the valves in the carburetor and superheater more and admit more secondary air so as to burn the gases all up in the set, this will raise the heats. Increasing the blast pressure with a fixed opening would certainly increase the amount of combustible gases from the generator.

The Secretary—Another question I wanted to ask, was in connection

with the spray. I did not hear whether it was brought out in the use of the Collins' spray, when the spray is being worked hard, for instance when you are forcing in considerable oil and are obliged to raise the disk a little from its seat in order to get the oil in, are you still maintaining the form of spray which you desire? If any gentlemen can enlighten me upon that I should be pleased.

Mr. Africa—Mr. President, we as an experiment had one of the Collins' sprays attached outside of the carburetor, and forced water through it, setting it at various points. We found by raising the disk slightly it was possible to get the regular umbrella shape of spray, with a center spray going down through the middle of it, so in this position it will distribute the oil evenly over the top of the carburetor. If the checkerbrick in the carburetor are too close to the nozzle of the oil spray, you will not get an even distribution of the oil. Forcing the oil in under too great a pressure has a tendency to throw the oil against the sides of the carburetor.

Mr. A. B. Slater, Jr.—I would like to hear something about the heating of the oil. I believe a question was asked regarding that, but I have not heard the answer. If I recollect the question, it was as to the temperature of the oil on entering the carburetor. I have tried from the cold oil direct from the tank, up to a temperature of about 600° F., and I finally concluded that after heating the oil up to about 200°, the gain beyond that was comparatively small, not worth the trouble of carrying it further, But when heating the oil by the gases coming from the superheater, as is commonly done, when you first begin to make gas on a run the heater is not very hot and your oil will go in to the carburetor at a comparatively low temperature to begin with, and then increase as your circulation of gas goes through your take-off pipe, and finally, toward the middle and latter part of the run, the entering oil would be very hot, so it goes in as a pretty hot vapor. But I believe that by heating the oil up to 200° we are able to get just as good practical results, as far as fuel and candle power relation are concerned, from the same oil as we were when we carried the heating further. In starting up, making the first run, the gentleman spoke of getting low candle power at that time, and it seems to me that that would be most apt to be caused by not fixing his oil sufficiently, not having his set hot enough for the amount of gas he starts in to make, or rather, putting in too much oil for the first heat, so that, as the gas goes over and through his seal pot, if he has tar there, it will absorb quite a lot of the heavier vapors, and then, after a set has run a while, so that tar has warmed up considerably, the absorption would be less, and the set being hotter would more effectually fix his vapors, so that he would not lose so much in the seal pot by absorption.

The Secretary—Mr. President, this may be a little bit aside, but still it is nearly in line. I would like to ask for an expression of opinion as to the relative value of coke and anthracite in the generator.

The President—You have heard the question, gentlemen. Who will answer it?

Mr. Barnum—Mr. President, I have figures in regard to that (I have not all that I have taken here) figured on the combustible, and the way we figure it is this. The amount of combustible charged is figured thus: The cinders from the generator we threw over a screen; ½-inch holes. The combustible left in the cinders from the front of the screen was taken from the amount charged. The combustible per 1,000 was, for coal, 27.4; for coke, 28.8. That was with an old machine. With a newer machine, if I remember rightly, I think it was 25 and 26, with the credit still on the coal side, being 1 pound less of coal than of coke per 1,000 feet of gas. Taking the amount of fuel charged and fuel recovered and credited in the same manner, on the same basis, there were 28 and 29 pounds, this being in favor of the coal again, and within 1 pound in each case.

Mr. Addicks—I would like to ask the last speaker as to whether in going from coal to coke the capacity of the machine for making gas in a given time was increased or decreased.

Mr. Barnum—I can't answer that question directly. In regard to the two tests, one was taken one week; say this week we ran the coke test, then we changed and ran three weeks on coal, and then took the test of coal. That is the way I remember it. Perhaps Mr. Humphreys can tell you that.

Mr. Addicks—I don't want it in actual figures, but merely in a general way. For instance, your machine could be counted on in 12 hours for 500,000 cubic feet with coal; how much could it be counted on when using coke?

Mr. Barnum—The machine gained about 16 per cent. on capacity when using coal.

Mr. Addicks—That has been our experience, and I wanted to see whether it was confirmed.

The Secretary—In moving a vote of thanks to Mr. Leonard for his paper I would call attention to the fact, which I presume you have noticed, that nearly all of the authors of papers this year are men who have not frequently appeared here as authors of papers. I want especially to thank Mr. Leonard, but I also want to call attention to the matter of questioning. Some of us young men, who are rather diffident sometimes, may object a little to being questioned. I recollect that one of our past Presidents turned over to me a letter from a member of the Association, saying he thought the welfare of the Association demanded that the practice of questioning authors be abolished. I decidedly object to this practice being suppressed, because I think a good deal of valuable information has been brought out by these questions. Even if some of them seemed a little pointed, I want to encourage Mr. Leonard to think that by answering the questions he has done the Association and the members a great service. Personally and officially I wish to thank him.

Mr. Addicks—Mr. President, I am sorry I did not have the opportunity to move this vote of thanks, but I should like to second it. I know the incident to which the Secretary refers, and I don't think that Mr. Leonard or any of the gentlemen who have read papers here could have a better compliment than to have all these questions put to them. I wish to say that I not only congratulate Mr. Leonard on his paper, but also to congratulate him upon the way in which he handled himself and the questions, and to further say that I take a certain pride in the way Mr. Leonard carried out his tasks, as he was formerly connected with the Boston Gas Company. [The vote of thanks was adopted.]

Mr. Charles F. Prichard read the following

REPORT FROM COMMITTEE ON PRESIDENT'S ADDRESS:

To the Members of the New England Association of Gas Engineers: The committee to whom was referred the President's address, would respectfully report as follows:

While making no specific recommendations, the President has touched upon many topics prominently before the gas engineers of to-day, and the committee would recommend to the members of the Association a careful consideration of the matter treated.

The committee have noted the valuable information given, especially regarding electrolysis, Texas oil and gas pressures, and for the Association desire to express to the President their appreciation of the work and research involved.

It is with sincere regret that the committee learn that the Association is to be favored with but one President's address from the present incumbent, who has proved himself to be possessed of so able a hand and so clear a mind.

The committee desire to express the hope that the address of the President, together with proceedings of the meeting, be sent to the members in printed form.

CHAS. F. PRICHARD,
SAML. J. FOWLER,
WM. H. SNOW,
} Committee.

On motion of Mr. Nettleton, the report was received and adopted.

The President introduced Mr. A. B. Slater, Jr., of Boston, Mass., who read the following paper on

COAL GAS TREATMENT.

What I have to present for your discussion does not aspire to the dignity of a formal paper, but rather a short topic to draw out the results of various methods practised in the treatment of coal gas, and with special reference to the deposition of naphthaline. Among European gas works there appears to be a fair degree of uniformity in the methods of treating crude coal gas, but in this country methods vary very widely; and particularly in some of the older, small works do we often find that the gas on reaching the consumer delivers to him a fair amount of light and heat per cubic foot, but at an excessive cost to the producer, because of incomplete or faulty treatment of the crude gas.

A plant must be extremely small to afford to be without an exhauster, and no works pretend to be without purifiers. As to the other apparatus of various kinds to be found in coal gas plants, undoubtedly the original designers had definite ideas as to what they were intended to do to the gas, but sometimes they are so installed as to receive the gas under totally different conditions than contemplated by the designer; and it is not impossible that there may even be found an installation of excellent apparatus which fails of accomplishing the results of which it is capable, for it does not require a very incompetent or biased operator to permit good apparatus to go wrong.

It is generally admitted that the gas must be "condensed," but while the term should be understood as meaning the liquefaction and removal of undesirable vapors, it is often taken as meaning simply the removal of heat from, or, in other words, cooling the gas. The removal of the

heat from the gas is not in itself a principal point, but it is incidental, as producing conditions favoring the removal of undesirable components of the crude gas. To determine a method of treating the crude gas, its general composition must be considered, and also the desired composition of the commercial gas.[1]

Besides the desired components, there may also appear in the commercial gas some nitrogen, carbonic acid, aqueous vapor, and even traces of sulphur, because the advantage gained to either consumer or producer would be entirely incommensurate with the cost of their entire removal, especially if the illuminating and heating values of the gas are maintained.

The last hydrogen sulphide and carbonic acid are taken care of by the purifiers, and the free ammonia and remaining ammonium salts are taken care of by the ammonia washer scrubber, so that in the apparatus ahead of that it is the hydrocarbons that are to be particularly looked after. Of those in the crude gas in sufficient quantity to notice, only those of the more complex molecules are solids at normal temperature and pressure. These, therefore, will naturally be the first to condense on cooling the gas, and following these are those that are liquids under ordinary conditions, the principal ones being benzol, amylene, pentane and hexane. Of the normally gaseous illuminants, the olefines are the most valuable, but nevertheless the vapors of liquid hydrocarbons, especially the benzol, are largely relied upon for the real lighting power of the gas. It, therefore, is desirable to have the finished gas carry as much benzol vapor as the temperature conditions of distribution will allow. As we have a mixture of vapors to deal with, it is well to note that the partial tension of each component of a mixture is always less than the amount of its respective vapor tension when alone at the same temperature and pressure. With this qualification, Dalton's law of vapor tension holds practically good for our range of temperatures; that is, in a space already occupied by a gas, a liquid ultimately evaporates to the same extent as in vacuo, the process being merely more slow.

To retain in full relative tension the desirable vapors it is necessary to remove the heavy, tarry matter at as high a temperature as may be after leaving the hydraulic main, because the power of the tar and heavy vapors to absorb the other hydrocarbons increases with the decrease of temperature. To remove the tar without materially reducing the temperature requires some apparatus which will handle the gas at high velocity; as, for example, the Pelouze and Audoin condenser, which removes the tar by friction, and also by taking advantage of its inertia during sudden changes of direction of the gas flow. The same thing is also accomplished by using a fan exhauster as a centrifugal tar extractor. If, however, this apparatus is allowed to receive the gas *too cool*, trouble will be apt to follow from naphthaline, as has been the case in many instances. If much naphthaline is formed by conditions of distillation at high heats, or by allowing the gas too much or too long contact with the hot coke and retort, it will be carried as a vapor, mostly by the hot tar, the benzols, and the aqueous vapor. As the temperature of the tar reduces, it will absorb much naphthaline on liquefying, but also much of the benzols, and as the vapor of the benzol is excessively reduced by scrubbing through the tar films or by too much contact with tarry surfaces, if the tar is not *hot*, the remaining naphthaline vapor passes on at the point of saturation for that temperature, only to be dropped and crystallize at every material reduction of temperature, especially as the drop of temperature reduces the amount of aqueous vapor, whose carrying capacity decreases more rapidly than its vapor tension. We, therefore, find that under such circumstances the naphthaline will crystallize as a fine mist, and be often carried long distances, being rapidly collected by any obstruction, sudden change of direction, or even rough spot on the interior of the pipe. In the works and distribution this will be noticed at every point affecting the aqueous vapor tension; for instance, the effect of warm days on the gas in the holder, retaining the naphthaline with the gas, when it will crystallize in the cool of the evening on following the pipes, a fairly rapid circulation carrying it to the services and depositing it, even in those having slow flow from a main in which the velocity is fairly high. It is necessary, therefore, that the tar be removed as hot as possible, thereby avoiding excessive reduction of the illuminating vapors. After removing the tar the gas then contains more or less soot, and the vapors of heavy oils, which may be allowed to agglomerate during slow reduction of temperature, as the resulting liquids will take in solution much of the naphthaline without undue absorption of desirable illuminants. If, therefore, at this point the aqueous vapor is at a minimum, the naphthaline will also be reduced to the amount carried by the benzol, and as benzol is a very good solvent for naphthaline, it will rarely be the case beyond this point that any naphthaline will be deposited, unless conditions are such that some benzol is also condensed, and in that event it will dissolve and carry the naphthaline until the benzol is allowed to evaporate to the air, when the naphthaline may be left behind, as is sometimes seen on leaky holders.

In 1884, at the South works of the Providence Gas Company, subsequently operated by the writer, was installed a P. and A. condenser, that being at a time when the P. and A. was often condemned, and it was by a long series of experiments that the naphthaline subject was gradually developed, so that finally it became possible at will to cause naphthaline to appear in the distribution, or at specified points in the works themselves, and this control finally made possible the avoidance of the naphthaline trouble almost entirely, an instance of it being particularly noticeable at a time when the West works, for reason probably accidental but unknown to the writer, were averaging for several weeks over 100 calls a day for bad lights found to be due to crystals, while the South works, sending out over one-third the amount of gas, through proportionately longer mains, at the same time averaged less than two calls, although both works were using the same kind and condition of coal distilled in the same kind of setting.

The P. and A. condenser is referred to simply as a type, and not as the only suitable apparatus, although any apparatus which may add aqueous vapor to the gas is not, in my belief, as desirable; for, as will be understood from the foregoing, it is very desirable to keep the aqueous vapor at the lowest practicable point until the naphthaline has been reduced to that proportion which the benzol alone can easily carry.

In cooling the gas the writer has always secured the best results when the heat removed per minute from the same quantity of gas was uniform, or graphically, with ordinates of temperature and abscissae of time the locii of gas temperatures formed a line as nearly straight as practicable.

In practice it is found that the best results are attained by slow cooling, as the heat receiver need then have its initial temperature but little below that of the cooled gas and undesirable reactions are avoided. This calls for low velocity for the gas, and consequently large areas of passages, but if the operation be divided, using an air cooler for the first and water cooler for the second part, the desired uniformity of rate of cooling may be attained with but a small quantity of water, although an analysis of the heat transference shows that the form of water cooler should vary considerably from the usual pattern, the number or area of the tubes being much greater per 1,000 cubic feet, and the tubes being very much shorter.

If, then, the heavy vapors are removed in the air cooler, and the gas contains a minimum of aqueous vapor, insuring a minimum of naphthaline, it may be washed with strong ammoniacal liquor before entering the water cooler, a part of the remaining heat in the gas serving to free some of the ammonia which will react with many of the impurities of the gas forming soluble ammonium salts, and thereby greatly relieve the purifiers. It is important that the velocity of the gas be low and that the ammonia be in excess, as otherwise some of the desired reactions would be difficult to develop without having the temperature below what would be sufficient to liberate sufficient ammonia gas from the liquor. Although this method increases somewhat the work of the ammonia scrubber, the advantage at the purifiers more than counterbalances it. If this be done, it should be immediately followed by reduction of the temperature in the water cooler sufficiently to prevent increasing the aqueous vapor in the ammonia scrubber or the carrying of any taken up during the washing by the ammoniacal liquor, and in any event the gas might well be cooled to as low a temperature as it will meet in the distributing system, although it must not be too cool while passing through the purifiers, as low temperature would interfere with the action of the oxide.

Some further deductions from the foregoing are: Carry fairly high heats to properly utilize the producing capacity of the retorts, but charge heavily also for the same reason and also to reduce the gas space above the coke, thereby increasing the velocity of the gas leaving the retort, so as to prevent the gas being cracked through overheating by too long contact with the hot coke and retort. Connections from retort to hydraulic main should be as straight as possible and of liberal size. Very short connections facilitate the carrying over of fixed carbon to the hydraulic main where it will be caught by the heavy tar, and if allowed to stand will tend to form a thick paste or even a sort of concrete, while on the other hand too long connections may apparently favor the hydraulic main but with corresponding increased tendency for the pipes to stop up. Keep in motion the tar in the hydraulic main and remove it as fast as possible to prevent its accumulating the fixed carbon, which,

1 See Appendix. For a more detailed list: See A. G. L. A. Proceedings, Vol. II., page 91; also, "Mills' Destructive Distillation;" "Lunge's Tar and Ammonia;" Humphrys' "Chemistry of Illuminating Gas;" and many others.

as it comes over from the retort, if allowed to accumulate, is usually responsible for the troubles commonly said to be due to the hydraulic being too warm and pitching the tar.

As a matter of fact, the hydraulic should be guarded, especially in cold weather, from any cold wind, as the effect of the chill would certainly be to increase the viscosity of the tar and interfere with its removal. The seal in the hydraulic is preferably maintained by using gas liquor and not cold fresh water, which would chill the tar and absorb a very appreciable quantity of the gas if used in excess, while the gas liquor would not act as an absorbent, to any extent, of any of the desirable components of the gas, but would tend to somewhat increase the relative amount of free ammonia, thereby favoring subsequent treatment.

The Theory of the Incandescent Mantle.

A paper read at the Ninth Annual Meeting of the Michigan Gas Association, Kalamazoo, Feb. 19, 1902, by Messrs. A. H. White, H. Russell[1] and A. F. Traver.[2]]

In a paper[3] read at the last annual meeting of the Association, entitled "Relation of Heating to Lighting Power of Gas, with Special Reference to Incandescent Mantles," some results were given of the first six months' research work under the Michigan Gas Association Fellowship at the University of Michigan, The paper was largely a preliminary one, dealing with the methods used, precautions taken and standard conditions adopted to insure uniformity and accuracy of results. In the work the position was taken that the proper way to test a mantle was to adjust both air and gas supply for the highest illumination under proper conditions of pressure, irrespective of how the gas consumption might vary. This was in opposition to published results and the official method of the German Gas Association, where the consumption was directed to be kept at a constant amount per hour, but the recent change in the official method of the German Gas Association to a method similar in principle confirms the propriety of the innovation.

It was found that no matter what gas was being used with the mantle, whether water gas, coal gas, or natural gas, when the burner was so adjusted as to give the maximum illumination—that is, the highest total candle power obtainable—the point of highest efficiency was also reached; the term "efficiency" as here used meaning simply the candles per cubic foot of gas consumed. Thus a gas giving 20 candles per cubic foot under the most favorable conditions of burning, was said to have a higher efficiency than another giving 16 candles per cubic foot under the came conditions.

The former paper also contained the results of some experiments on the variation of illumination with the heating value of the gas. It was shown that no relation at all existed between the light emitted by a flat flame and the heating power of the gas, but that there was a very close relation between the heating power and the amount of light the gas gave with an incandescent mantle. These experiments have been continued and the results afford more data for discussion. They may be grouped in two series. The first series was made entirely upon one mantle and Welsbach "C" burner with an 8-inch chimney. The pressure was kept constant at 2 inches at the burner tip, and the burner was

1. Holder of the Mich'g an Gas Association Fellowship at the University of Michigan, 1900-02.
2. Holder of the same Fellowship, 1901-02.
3. See JOURNAL, April 1, 1901, p. 488.

APPENDIX.

Principal Components of Crude Coal Gas.—Temperatures are given in Centigrade.

Name.	Symbol.	Normal State.	Boiling Point.	Specific Gravity.	Cu. Ft. Per lb.	Solubility in Water.	Luminosity of Flame.
Hydrogen.	H_2	Gas		.0693	188.42	.0193 to 1	Slight blue.
Marsh gas (methane).	CH_4	Gas	−164°	.556	23.55	Small	Very slight.
Other paraffines (incl. butane).	$CnH_2n + 2$	Gases	Below 2°	1.000 to 2.000		Very small	Increases with carbon but in less ratio.
Pentane.	C_5H_{12}	Liquid	38°	*2.489	5.29	Almost insol.	As last above.
Hexane.	C_6H_{14}	"	68°	*2.975		" "	" "
Heptane.	C_7H_{16}	"	98°	*3.465		" "	" "
Ethylene (olefiant gas).	C_2H_4	Gas	−102.5°	.968	13.46	.16 to 1	Very good.
Propene.	C_3H_6	"	−61.°	1.498	8.8	Small	" "
Butene.	C_4H_8	"	−5.°	1.936	6.8	"	" "
Amylene.	C_5H_{10}	Liquid	35°	*2.419	5.45	Very small	" "
Amines (mostly methyl).	$(C_nH_n)nNH_3$	Gases	0°	1.073	10. ±	Very soluble	Fairly good.
Acetylene.	C_2H_2	Gas	−85°	.920	14.48	1 to 1	Very fine.
Benzol.	C_6H_6	Liquid	80.4°	*2.695	4.88	Almost insol.	" "
Other benzols.	CnH_2n-6	"	111 to 230°			" "	Very good.
Toluene.	$C_6H_5CH_3$	"	111°	*3.179	4.14	" "	" "
Naphthaline.	$C_{10}H_8$	Solid	218°	*4.423	2.98	Insoluble	Quite good.
Diphenyl.	$C_{12}H_{10}$	"	254°	*5.33			" "
Anthracene.	$C_{14}H_{10}$	"	360°	*6.18			" "
Pyrene.	$C_{16}H_{10}$	"	Very high	*6.98		Similar to	Naphthaline.
Chrysene.	$C_{18}H_{10}$	"	" "	*7.82		"	"
Carbonic oxide.	CO	Gas	−193°	.967	13.46	Nearly insol.	Practically None.
Carbonic acid.	CO_2	"	−78°	1.527	8.56	.975 to 1	Incombustible.
Carbon disulphide.	CS_2	Liquid	47°	*2.645	4.95	Nearly insol.	Blue.
Hydrogen sulphide.	H_2S	Gas	−62°	1.191	11.09	3.17 to 1	"
Nitrogen.	N_2	"	−193°	.971	13.46	.15 to 1	No flame.
Oxygen.	O_2	"	−181.4°	1.105	11.77	.029 to 1	" "
Aqueous vapor.	H_2O	Liquid	100°	.622	20.93		" "
Ammonia.	NH_3	Gas	−33°	.590	22.17	712 to 1	Slight blue.
Ammonium.							
Cyanides.							
Carbonates.							
Sulphides, etc.							
Heavy tar vapors.							

* Vapor.

DESIRABLE COMPONENTS OF COMMERCIAL COAL GAS. } Hydrogen. Paraffine series, up to hexane. Olefine series up to amylene. Acetylene. Benzols. Carbonic oxide.

MEMORANDA.

Propene.—Small quantity in the crude gas.

Butine.—Considerable quantity.

Amines.—Extremely soluble in H_2O.

Easily decomposed by heat = $6H_4 + NH_3 + HCN + H_2$.

Contain ammonia.

Acetylene.—Not very soluble in coal tar.

Benzol.—Decomposed by heat to diphenyl and hydrogen.

Diphenyl.—Is formed by overheating benzol vapor yielding about 50 per cent. Boils at 254°.

Naphthaline.—Formed at high heat. Produced by overheating toluene, a mixture of ethylene and benzol, anthracene or chrysene, ethylene alone, acetylene, or a mixture of acetylene and benzol.

Properties.—Melting point 79°. Monoclinic tables, insoluble in cold and nearly insoluble in hot water, very soluble in alcohol, ether, benzol and essential oils, also acetic acid. It is volatile with steam; 1 part distilling with about 570 parts water. It burns with smoky flame. When overheated yields methane and dinapthyl. When overheated with aqueous vapor is mainly unaltered, but yields some acetylene and benzol; but with acetylene yields much anthracene. It is usually 4 per cent. to 6 per cent. and sometimes even 10 per cent. (by weight) of coal tar, being about the same in by-product coke oven tar as in retort gas tar, and being found in the light oils distilling, at from 180° to 250°, most abundantly in the carbolic oils. In general the solubility of naphthaline in tar oils increases to a certain limit with the temperature. Sp. gr.; solid, 1.1517; liquid, 0.97. The tension of aqueous vapor at 59° F. (about 16° C.) is ½ inch of mercury; say, about ¼ pound per square inch.

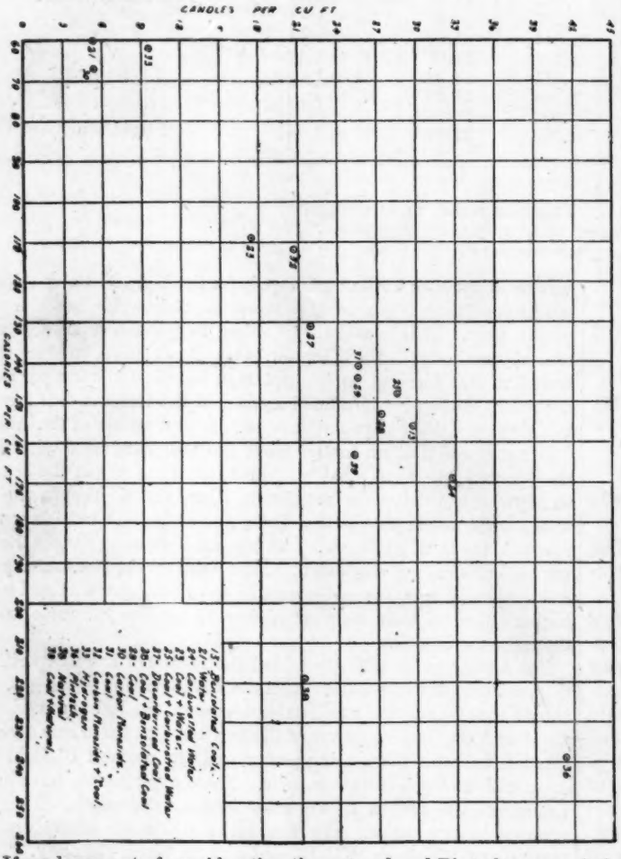
[To be Continued.]

adjusted to give the greatest amount of light, the gas and air supply being changed till the point was reached where the photometer showed highest candle power. The results are set forth in Table I., and also given in Plate I., which shows graphically the relation between the net heating value and the number of candles given per cubic foot of gas. By net heating value is meant the lower value obtained in calorimetric tests if the water formed in combustion is not figured as being condensed but as escaping in the form of steam.

TABLE I.—*Comparison of Heating Power of Various Gases and their Illumination with the Incandescent Mantle when Adjusted for Highest Illumination. Welsbach "C" Burner. Same Mantle Used Throughout the Tests.*

Gas.	Calories per Cubic Foot. Gross.	Net.	Pressure in 1-10th inches	Gas Burned Cu. Ft. per Hour.	Total Candle Power.	Candles per Cubic Foot.
21. Water gas	61.80	60.24	22	7.58	41.92	5.53
23. Coal and water gas	119.70	108.90	20	5.20	91.00	17.50
27. Decarburized coal	146.50	130.90	20	3.56	77.83	21.86
29. Coal gas	160.50	144.30	20	3.25	82.65	25.40
25. Coal and carburetted water gas	163.10	147.86	21	3.40	96.67	28.48
28. Coal and benzolated coal gas.	169.67	153.83	20	3.50	95.91	27.40
13. Benzolated coal gas	179.80	156.10	21	3.10	92.24	29.75
24. Carburetted water gas	182.35	169.60	20	3.15	103.73	32.90
30. Carbon monoxide	67.03	67.03	20	4.93	27.13	5.54
32. Carbon monoxide and coal gas	125.33	112.11	20	4.95	102.45	20.69
33. Hydrogen	75.95	62.39	20	7.20	69.63	9.67
36. Pintsch gas	260.68	239.38	20	1.80	74.96	41.63
38. Natural gas	242.43	219.28	20	2.05	45.90	22.94
39. Coal and natural gas	180.21	162.96	20	3.00	76.30	25.43
31. Coal gas	156.18	140.55	20	3.45	87.04	25.60

PLATE I.—*Comparison of Heating Power of Various Gases and their Illumination with the Incandescent Mantle when Adjusted for Highest Illumination. Welsbach "C" Burner. Same Mantle Used Throughout the Tests.*



If we leave out of consideration the natural and Pintsch gas and the mixed gas No. 39, containing much natural gas, as being outside the range of ordinary practice, the results as shown in Plate I. range themselves fairly well along a straight line. The increase in illuminating power is approximately at the rate of 1 candle per cubic foot for every 4 calories increase in the net heating value.

Prompted in part by the discussion at the last meeting as to how far 1 burner could adapt itself and its air supply to the wide range of gases covered, another series was undertaken. A different burner was chosen—a Humphrey—and a different mantle was necessarily used so that the results under the two series cannot be directly compared with one another. The Humphrey burner was modified in so far that a brass shell was fastened around the burner tube inclosing the air inlets, compelling all the air to pass through a ¾-inch tube into this shell before it passed into the burner. A meter could be placed before this air inlet and any desired amount of air blown into the burner. The air supply tube was provided with a U-gauge to determine if the amount of air forced in was so great as to cause it to issue from the burner nozzle under pressure, but even with the richest gases the burner allowed sufficient air to pass without an appreciable plus pressure. The method of conducting the experiments was to set the gas consumption to a figure which gave good results, regulate the air supply to maximum brilliancy and make the observation. The gas supply was then changed slightly, the air supply readjusted for highest illumination and another observation taken. The process was repeated until it seemed certain that the maximum light represented closely the best results attainable with that particular gas. As a sample, the results with gas No. 41, a coal gas enriched with benzene vapors, are given in full in Table II.

TABLE II.—*Detail of Adjustment for Highest Efficiency. Burner, Humphrey Modified. Gas No.* 41, *Coal Enriched with Benzene. Net Heating Value,* 162.8 *Calories per Cubic Foot.*

Pressure in one-tenth ins.	Gas Con., cu. ft. per hr.	Air Con., cu. ft. per hr.	Ratio air to gas.	Theoretical Ratio air to gas.	Per Cent. of theoretical used.	Total candle power.	Candles per cu. ft.
20	4.00	24.00	6.00	6.60	90 9	105.3	26.3
18	4.06	23.10	5.69	6.60	86.2	98.3	24.2
20	4.00	23.22	5.80	6.60	88.0	103.4	26.1
20	3.72	22.56	6.00	6.60	90.0	95.72	25.7

The first and third experiments give results in almost exact agreement. If the gas consumption is increased or decreased much from the 4 cubic feet used in these two experiments, the candle power will be lower, however carefully the air supply is adjusted to the gas. We conclude, then, that this burner is working under the best conditions with this particular gas, when, as given in the first test, it is burning 4 cubic feet per hour, and is drawing it through the air holes 90.9 per cent. of the air theoretically necessary to completely burn that gas. Under these conditions it will give a light of 105 candles, or 26.3 candles per cubic foot of gas burned per hour. The results of experiments made in this way on six gases are given in Table III., the conditions for highest illumination being picked out for presentation. It will be noted that the amount of air passing through the burner lies between 80 and 90 per cent. of the air theoretically required to burn the gas, part of the remainder leaking in between the mantle and the cap, the rest of the air necessary meeting the partially burned gases as they emerge through the mantle and completing the combustion. If this series is plotted in the same way as the first series in Plate I., it will be found that 4 of the 6 results lie almost on a straight line, and that every increase of 4 calories per cubic foot in the net heating value of the gas causes an increase of approximately a candle power in its lighting value, as in Plate I.

TABLE III.—*Comparison of Heating Power of Various Gases, and their Illumination with Incandescent Mantle, when burning under most favorable Conditions. Modified Humphrey Burner, and same Mantle throughout.*

Gas.	Calories per Cu. Ft. Gross.	Net.	Pressure in 1-10th Inches.	Gas Burned cu. ft. per Hour.
40. Coal	157.3	142.2	20	4.4
41. Benzolated coal	177.9	162.8	20	4.0
42. Natural	234.2	211.2	21	2.95
43. Natural and coal	212.95	193.75	20	3.26
44. Pintsch	260.2	240.6	20	2.85
45. Pintsch and coal	204.5	187.7	20	3.70

Air Used—Cubic Foot per Hour.	Ratio. Air Gas.	Theoretical Ratio. Air Gas.	Per Cent. of Theoretical Used.	Total Candle Power.	Candle Power per Cubic Foot.
21.33	4.84	5.84	82.8	89.70	20.40
24.00	6.00	6.60	90.9	105.30	26.30
24.00	8.14	10.20	80.0	84.82	28.75
23.70	7.17	8.40	86.5	99.88	30.04
24.54	8.61	10.18	84.5	120 44	44.37
24.90	6.73	8 24	81.7	117.77	31.83

If these two series, as given in Tables I. and III., be directly compared, it will be seen that the lighting power of the gases Nos. 41 and 40, which are within the range of ordinary practice, are lower with the Humphrey burner than with the Welsbach "C." This need not be laid to the burner, because 2 different mantles had to be used in the 2 series, and by actual comparison the mantle used in the first series was

found to be considerably the better of the two. The natural gas, No. 38 and No. 42, is identical in both series, though its experiment number is different, and in the same way the Pintsch gas, No. 36 and No. 44, is the same. These two gases show a higher value in the second series than in the first, in spite of the inferior mantle.

	Candles per Cubic Foot.	
	Series I.	Series II.
Natural gas	22.94	28.75
Pintsch gas	41.63	44.37

This increase can be due only to the modification of the apparatus to insure proper air supply. The Pintsch gas has now risen to its proper place on the line of increase at the rate of approximately 1 candle for every 4 calories. The natural gas and its mixture still fall below the line. This certainly cannot be due to inadequate air supply, and a further reason must be sought for its deficiency.

The temperature of the mantle is certainly an important point to be considered in any study of this subject, but such temperature measurement is difficult, and as we have, further on in this paper, made use of a number of temperature measurements, which were made by means of a Le Chatelier thermo-couple, it is necessary to establish conclusively that the thermo-couple indicates the temperature of the mantle – at least relatively. The Le Chatelier thermo-couple is made by fusing together a platinum wire and a wire of an alloy of platinum and rhodium. This junction when heated gives an electric current whose electromotive force increases with increasing temperature, When properly calibrated it makes a very accurate pyrometer and is particularly well adapted for delicate work of this sort. It cannot indicate the temperature of a mantle absolutely, because the radiation and conduction of heat by the wires will prevent the couple attaining the true mantle temperature. The conduction of heat may be largely avoided by placing the thermo-couple vertically against the mantle so that the wires above the couple are heated for a distance of about 2 inches as well as the couple itself. The loss by radiation cannot be avoided. It will vary with the size of the wire, and in order to render the correction as small as possible, wires 25-hundredths of a millimeter in diameter were employed at first, and later wires 19 hundredths of a millimeter, which are as fine as can well be used without frequent breaking. The error is still considerable, as may be seen by comparing the results obtained by these two couples. Each of these thermo-couples was standardized by placing it in a porcelain tube in a furnace with a standard thermo-couple with the certificate of the German Physikalische Technische Reichsanstalt, and comparing the electromotive force of the two. When thus heated in a closed tube, they differed from one another only slightly, but when directly compared, by placing them in succession on the surface of an incandescent mantle, the finer couple showed the temperature to be apparently 90° C. higher than the coarser. This difference can only be due to the larger surface, and hence the greater amount of heat radiated by the larger thermo-couple and its wires preventing it from attaining the true temperature as closely as did the finer couple. We have spent much effort in an attempt to obtain a correction for this loss by radiation by making thermo-couples with varying and very fine diameters, standardizing them in a closed tube and afterwards directly comparing them on the surface of a mantle, in the hope that the results, when plotted graphically, would give a curve which would allow of extrapolation to a couple of infinitely small diameter, where there would be no correction for radiation. But the amount of extrapolation necessary with the finest wires we have been able to obtain is so considerable that we prefer not to attempt to apply any correction. We therefore give the results as obtained with a couple of 19-hundredths millimeters diameter, or of 25 hundredths millimeters diameter, as the case may be.

The point might be taken that because there is active combustion taking place at the surface of the mantle, the couple would register the flame temperature and not the mantle temperature. That this is not the case has been shown in two ways.

A fragment of a mantle, about ½ inch wide and 1 inch long, was suspended by a fine platinum wire in the flame of the burner, so that it was surrounded on all sides by the flame. The fine thermo-couple placed vertically in the flame about a millimeter from the surface of this fragment, showed a temperature of 1,453° C. When moved over slightly so that the couple and wires were flat against the fragment the temperature recorded dropped to 1,353° C. The free flame, a similar distance on the other side of the fragment, showed 1,430°, while the couple, moved over slightly until it was flat against the mantle again, showed 1,353°. The couple then shows a difference of 90° when placed against the mantle or in the free flame. This difference can be due only to the mantle's being colder; a difference which the couple indicates incompletely but decisively.

In order to more closely follow the conditions prevailing in actual use, a slit about ½ inch wide was cut vertically out of a mantle from near the top down almost to the level of the cap. This allowed the couple to be introduced to get the temperature of the inside of the mantle. The wires were bent at right angles so that about an inch of the wires above the couple was in contact with the mantle both in measurements inside and outside. According to one experiment with the .19 mm. couple the temperature of the free flame on the inside of the mantle one millimeter from the mantle was 1,523° C.; with couple touching mantle on inside, 1,373°; couple touching mantle at same point on outside, 1,370°; couple moved ½ millimeter off mantle on outside, 1,360°; one millimeter off, 1,342°, etc. Experiments like the above, repeated at different times and with different mantles, have shown that the thermo-couple, when placed in contact with a mantle, will in every case indicate clearly a large difference between the temperature of the flame and the mantle. Such being the case it must also show any considerable difference between the temperature of two mantles placed successively in the same flame, and if the thermo-couple indicates no marked difference, there can be no large variation in their temperatures.

In determining the relation between temperature and candle power it was found necessary to work with only a small portion of the surface of the mantle on account of the marked differences in temperature and illumination between different points and the unsteadiness of the flame in the upper portion of the mantle. The desired result was obtained by interposing between the lamp and photometer, at a distance of 2 inches from the center of the lamp, a curved screen of blackened brass, having in it a slit $\frac{2}{16}$ inches by $\frac{3}{4}$ inch, about the size and shape of the slit on the Edgerton sleeve, and in such a position that the light issuing from this orifice came from the hottest zone of the mantle; that is, about ¼ inch above the cap. In this position the small surface furnishing the light was of nearly uniform brightness and temperature. The 25-hundredths millimeter couple was placed exactly in the center of this area, its wires fitted tightly to the mantle for a distance of about 2 inches. It was found by experiment that the temperature registered by the couple in this central position was a fair average of the surface under consideration. By now changing the consumption and pressure of the gas, differences in the temperature and illumination of this area could be brought about and measured.

As it was thought possible that the temperature of this rectangular space might not be sufficiently uniform to give fair results, a smaller circular aperture $\frac{5}{8}$ inch in diameter was substituted for the larger opening in the screen, other conditions remaining the same.

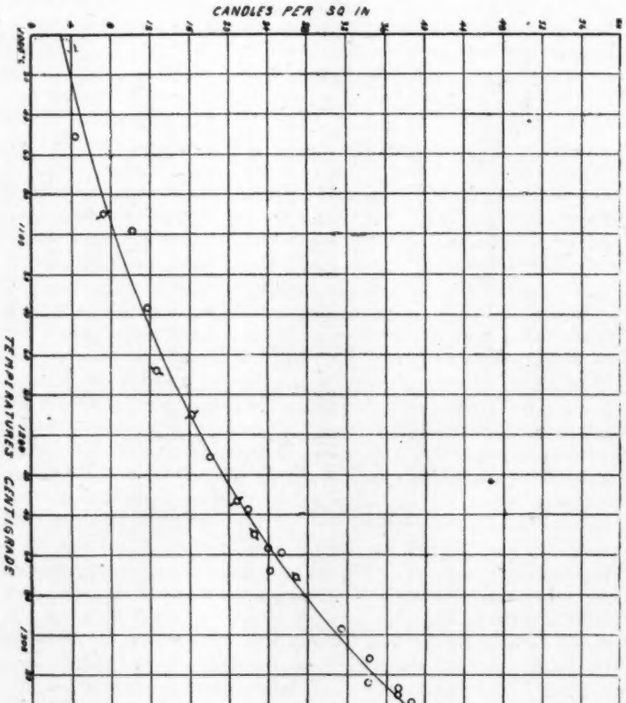
TABLE IV.—*Variation of Candle Power with Temperature. Same Mantle Through Tests. Temperature as Given by Thermo-couple, .25 mm. Diameter.*

Experiment Number.	Gas Consumed.	Gas Pressure.	Temperature .25 mm. Couple.	Candle Power.	Candle Power per Square Inch.	Remarks.
23...	3.00	16.0	1,348	12.4	3.71	Rectangular slit.
"	2.40	16.5	1,238	7.5	21.9	" "
"	3.00	16.7	1,327	12.9	37.7	" "
"	2.47	16.7	1,257	8.2	24.0	" "
"	3.10	16.7	1,330	12.7	37.2	" "
24...	2.90	16.7	1,312	11.7	34.3	" "
"	2.75	16.7	1,297	10.5	31.4	" "
"	2.50	16.7	1,211	6.2	18.1	" "
"	2.60	16.7	1,264	8.9	26.0	" "
25...	....	....	1,088	2.5	7.3	" "
"	....	....	1,098	3.1	9.1	" "
"	....	....	1,137	4.0	11.7	" "
"	....	....	963	.4	1.2	" "
"	....	....	1,051	1.5	4.4	" "
29...	3.00	17.0	1,324	11.7	34.2	" "
"	3.10	17.0	1,334	13.2	38.6	" "
"	2.95	17.0	1,338	13.8	40.3	" "
31...	3.20	16.8	1,268	2.9	26.3	⅝-inch round orifice.
"	3.10	17.0	1,259	2.8	25.4	" "
"	3.00	17.0	1,250	2.5	22.6	" "
"	2.90	17.0	1,233	2.3	20.8	" "
"	2.70	17.0	1,190	1.8	16.3	" "
"	2.50	17.0	1,168	1.4	12.7	" "
"	2.20	17.0	1,090	.8	7.2	" "

The results of both tests are stated in Table IV. In all these experiments the same mantle was used, and the same thermo-couple placed in the same way on the same point of the mantle. The only variable factors were the consumption and pressure of gas, kind of gas and the size of the aperture in the screen. The temperatures are given in degrees

C. with the reservation, as explained before, that they are known to be too low. The last column of the table gives the illumination figured for a square inch of mantle surface of recorded temperature, and Plate II. shows graphically the relation between illumination per square inch and degrees C.

PLATE II.—*Variation of Candle Power with Temperature. Same Mantle throughout tests. Temperature as given by Thermo-couple, .25 mm. Diameter.*



The results of both series of experiments are plotted on the plate, and the close agreement of these experiments made on different days and with different diaphragms is strong evidence of the accuracy of the work. The curve shows strikingly the rapid increase of illumination for slight differences of temperature, particularly as the upper temperatures are reached, and explains how the use of high pressure gas which facilitates quick combustion and high temperatures renders possible the production of very high candle powers.

The views prevailing on the cause of the luminosity of a mantle have changed much in the last few years. The investigations of Le Chatelier and Boudouard, and Nernst and Bose showed without a doubt that there was no particular charm in the gas flame which caused the illumination, for the same results could be obtained by heating electrically or by means of the waste gases of combustion. These investigators came to the conclusion that the particular mixtures of oxides used in making mantles gave more light because they attained a higher temperature than other substances when placed in a flame, and that they attained this higher temperature because they emitted less of the heat waves than other bodies and hence more nearly reached the temperature of the free flame surrounding them. They held that the particles of glowing carbon in a flat flame burner gave off more of the energy they received from the flame as heat and did not reach such a high temperature and so gave less light.

It is well known that a mantle made of pure thorium oxide free from cerium emits very little light, and, therefore, according to the theory of Le Chatelier and Nernst, must be at a relatively low temperature. Through the courtesy of the Welsbach Company we were provided with a set of mantles made by them especially for these tests. No. 1 was pure thorium oxide without cerium oxide ; No. 2, thorium oxide with ½ per cent. cerium oxide, and No. 3, thorium oxide with 1 per cent. cerium oxide. In the tests with these special mantles the same burner was used, the mantles being transferred to it successively, the gas pressure and consumption were kept constant, and the couple was always placed at the same relative point on the mantle.

With the No. 1 mantle of pure thorium oxide the illumination was only 2.4 candles, and with the screen in position the light from the slit was .6 candles. The 19-hundredths millimeter couple placed against the mantle in the center of this area indicated 1,373° C. When the No. 2 mantle, with ½ per cent. cerium oxide, was substituted, the temperature indicated rose only to 1,382°, but the total candle power was 32.6 candles and the light through the slit 8.4 candles. The No. 3 mantle with 1 per cent. cerium oxide gave 48.1 candles from the whole mantle, 9.5 through the slit, while the temperature dropped to 1,365°—below what the dully-glowing thoria mantle showed. These experiments, repeated on different days, gave concordant duplicates. The figures are given in Table V.

TABLE V.—*Influence of Cerium on Temperature and Illumination.*

Exp. No.	Mantle.	Gas Cons.	Gas Pres. in 1-10th in.	Mantle Temp. .19 mm. Couple.	C. P. Slit.	C. P. Total.	Remarks.
70	No. 1 Special	2.95	17	1,373	.6	2.4	same mantle.
96	No. 1 Special	2.96	17	1,362	.6	....	
72	No. 2 Special	2.95	17	1,382	8.4	32.6	same mantle.
97	No. 2 Special	2.97	17	1,372	8.4	....	
73	No. 3 Special	2.95	17	1,365	9.5	48.1	same mantle.
74	No. 3 Special	2.95	17	1,365	9.7	47.5	
99	No. 3 Special	2.96	17	1,353	13.3	....	different mantle.

Apparently the great difference in illumination is accompanied by no change in temperature, the differences recorded being irregular and almost within the limits of experimental error. The results are in absolute disagreement with the theory of Le Chatelier and Nernst, which demands a very wide difference in temperature between the thorium mantle with its low illumination and the mantle with 99 per cent. thorium oxide and 1 per cent. cerium oxide, which gives in one instance 22 times the light from the given area while recording a lower temperature.

Similar experiments were tried on various makes of commercial mantles with the same result that the brightness did not stand in any definite relation to temperature, even when only the small area of the mantle represented by the slit in the screen was considered. Differences in temperature there were to the amount of about 50° C., but the differences in illumination did not correspond with change in temperature.

The mantles used in these tests were burned 24 hours, and then transferred successively to a burner on the photometer bench, whose consumption was kept constant at 2.95 cubic feet per hour with pressure of 17-10ths, so that its flame temperature should not vary. Table VI. gives the details of the tests.

TABLE VI.—*Temperature and Illumination of Various Commercial Mantles.*

Exp. No.	Mantle.	Mantle. Temperature .19 mm. Couple.	Candle Power. Total.	Slit.
64	A	1,404	52.1	11.8
63	B	1,394	49.3	12.1
58	C	1,390	55.5	12.1
61	D	1,383	40.9	8.8
49	E	1,379	50.7	12.2
57	F	1,377	50.7	12.3
60	G	1,371	36.2	8.3
54	H	1,370	24.3	5.3
47	I	1,366	37.1	9.3
48	J	1,365	35.4	8.6
52	K	1,364	29.4	6.6
51	L	1.357	46.9	8.6

We have felt it necessary to report at this meeting our experiments on this temperature measurement even though the work is unfinished. These temperature measurements indicate that while increased temperature does cause a marked increase in illumination, it cannot be held that it is the only reason for the much greater light given when gas is burned in an incandescent mantle. Some experiments which have not yet yielded sufficiently definite results to warrant presentation lead us to conclude, as a tentative hypothesis, that the oxide of cerium is held in a state of solid solution by the oxide of thorium, and that this dissolved ceria or solid solution of thoria and ceria exerts a specific influence in altering wave lengths, so that the mantle emits more of the blue and green rays and fewer of the red rays. That is, it converts more of the energy of the flame into light and less into heat than does the flat flame.

We hope that a series of experiments now in progress will enable us in the near future to give positive proof in support of these views.

THE proprietors of the Lansing (Mich.) Gas Light Company have arranged for an increase of its capital stock to $300,000, from $150,000.

Portland Cement and Coke Breezs.[1]

The cognate subjects of portland cement and coke breeze concrete were well threshed out at a recent meeting of the Discussion Section of the Architectural Association, when some valuable hints for constructors in this, the peculiarly modern building material, were placed upon record. The full reports of the paper by Mr. H. Howard Humphreys, which opened the subject, and of the various speakers' remarks, appear in the *Builder*, from which this abstract account is prepared. Those who are not well accustomed to the employment of cement and the preparation and use of concrete for building purposes, may be pardoned for failing to appreciate the perennial and absorbing interest of the study; but, in truth, the study is one for a lifetime. No engineering constructor can say that he knows all there is to know about cement; and novelties in the way of concrete construction are being brought out every day. Cement and mild steel are the conquests of the past century in the realm of building and engineering construction; and although engineers have accomplished many triumphs of strong, cheap, and rapid construction by their aid, architects have scarcely recognized the potentialities of the new materials. The reason for this is partly, no doubt, because both cement and concrete have limitations which are more easily discovered than their unique excellences.

The processes employed for the manufacture of portland cement are well known, and therefore need not be described; but in connection with the newest process of all, which is called the "Rotary Process," gas managers may feel a particular interest by reason of the fact that coal dust, not coke, is the fuel employed to burn the cement "slip" to clinker. The commercial influence of the Thames and Medway cement trade upon the local trade in gas coke has been, and is still, very considerable. It remains to be seen how far this will be changed by the success of the rotary system of cement burning, which is being installed at the Swanscombe works of Messrs. Bazley, White & Co. The cost of production by this process is reputed to be approximately three-fourths that of the cheapest of the older methods; while the product is credited with requiring much less aeration, Nothing in the way of a manufacturing process can seriously alter the nature of the product. The essential qualities of a good cement, according to Mr. Humphreys, are that it shall harden with reasonable rapidity under water; that it shall remain constant in volume; and that it shall develop considerable powers of adhesion and cohesion. The object of all testing is to ascertain how far these qualities are likely to be realized in a given sample. The customary 7-day test of the breaking strength of neat cement briquettes is no guide by itself as to the future behavior of the material. Other tests must therefore be used, with more especial reference to the determination of the sample's soundness, which is the most important quality of all, as it relates to the point of constancy of volume.

The best way to insure against a "blowing" cement, is to have it finely ground, and aerate it sufficiently before use. The test of the latter operation is that the cement should not be put into work until the heat developed after mixing with 20 per cent. of water does not exceed 6° in one hour. The old specification of weight per striked bushel is objected to. Mr. Humphreys relies upon chemical analysis taken in conjunction with the results of physical tests, but not otherwise. The chemical data to be looked for are: The proportions of soluble silica and alumina to lime, the proportion of magnesia, and the proportion of sulphuric acid. A sample ought not to contain more than 1¼ per cent. magnesia, 1¼ per cent. sulphuric acid, 1 per cent. carbonic acid, or 1 per cent. insoluble residue, and must not contain more than 62 per cent., or less than 58 per cent., of lime. Mr. Humphreys has great confidence in the Michaelis boiling test, which requires a mixture of neat cement to be made up with about 20 per cent. of water, set in damp air for 24 hours, and immersed in cold water raised to a boiling heat and maintained at that temperature for three hours. The test is admittedly very severe; but a good cement to be used for important works should stand it.

In using cement that has been binned, if lumps can be felt, it means that the sample has begun to set with the damp, and all such parts should be screened out. In regard to the preparing of concrete, Mr. Humphreys prefers for the aggregate clean broken stone with enough sharp sand, 40 per cent., to fill the voids. If round gravel must be used, it is advantageous to add some sound broken bricks to the mass. Burnt ballast is the worst possible material. The addition of furnace clinker to stone gives considerable toughness. Mr. Humphreys advocates the careful placing of concrete *in situ*, and does not approve of ramming. The mixture should always be turned at least 4 times, if by hand—twice dry, and twice wet, the water being added by a watering pot with a rose. The same general principles apply to cement mortars as in the case of concrete—the cleaner and more angular the aggregate, the better the composition. New work should be covered to protect it from the sun, the wind, or frost. Coming to the class of armored concrete, Mr. Humphreys thinks this kind of construction has a great future before it, especially as a check upon bricklayers. He lays stress, however, upon the importance of seeing that the metal buried in the concrete will not rust. The best preventive of this is a hot application of a dressing similar to Dr. Angus Smith's solution, but containing pitch and sand. One would think that this precaution should be observed whenever a concrete aggregate contained furnace clinker or coke breeze.

In opening the discussion, Mr. Max Clarke asked specially for information about coke breeze concrete. This was because he was connected with the British Fire Prevention Committee, who have definite ly decided that coke breeze concrete is the best concrete for resisting fire. Some persons say there are two sorts of coke breeze concrete—pan breeze and ordinary coke breeze; and Mr. Clarke wanted to know something about the relative values of these two different kinds of coke breeze. Mr. George Smith took up this point, and said he knew from experience that there are two kinds of coke breeze as stated, whereof the pan, or clinker, breeze is not nearly so satisfactory an aggregate for concrete making as the coke breeze proper. Another speaker mentioned the possibility of alterations being made in the manufacture of gas, and wanted to know "whether the altered gas process increased the sulphur in the residual coke, and whether it altered the coke so as to affect a coke breeze when used as an aggregate—whether more or less sulphur was in the coke; and, if so, whether it had a prejudicial effect when used as an aggregate?" It is difficult to follow this point.

Then, again, there is the question of the expansion of concrete after it has set, sometimes long after, which is usually attributable to the employment of too fresh, unaerated cement. Certain coke breeze floors were spoken of that had been laid as one block, 120 feet long; and these had slowly expanded from 6 to 18 months after they were finished. How does coke breeze concrete compare with other concrete in regard to expansion. Has the aggregate anything to do with this phenomenon? The speaker thought that coke breeze concrete is not so liable to expand as ballast concrete; or, if it did, it would expand vertically rather than horizontally. It was another part of the question of the possible effect of sulphur, which is always present in breeze. The speaker had "had a case in which a hot water pipe was laid in a pipe filled with coke breeze, and it rotted away in a very short time; and the explanation given was that there was sulphur in the breeze." One opinion was that the use of pan breeze for concrete should be prohibited; but another eminent architect who had the conduct of many large public buildings always specifies a mixture of pan breeze with coke breeze. There is much difference of opinion as to the effect of the concrete on iron buried in it; and the painting of the iron was strongly objected to by some, as tending to destroy the adhesion of the concrete to it.

It thus appears that one of the most important of the practical questions now agitating the minds of users of armored concrete in construction—which is, whether or no there is any corrosion of the metal to be feared when the aggregate is furnace clinker or coke breeze—remains open. The question refers to these aggregates, and to them only, because it has been completely established that iron and steel well buried in stone concrete do not rust. There is another highly important consideration in connection with the laying of concrete floors in their place, which was not dealt with in the course of the discussion. We allude to the employment of permanent centring as a substitute for the usual scaffolding. There are many varieties of these centrings, which are made of terra-cotta and are dropped in between the flooring joists. As these blocks are intended to remain, the concrete can be made with less cement than when the scaffolding is meant to be struck after a certain time. On the other hand, they add to the cost of the construction.

1. *Journal of Gas Lighting.*

The Metric System.

[By Mr. Godfrey L. Cabot, Boston.]

Permit me the privilege of your columns to say a few words in answer to the interesting article[1] of Mr. Chas. T. Porter, reprinted from *Electrical Engineering*, in your issue of the 17th inst. His chief argument in favor of our present cumbersome, unscientific, inexact, complicated and inconvenient system of weights and measures is precisely parallel with the criticism of an English accountant on our decimal system of coinage.

He complained, among other things, that it made it so hard to figure interest. He always had to convert his dollars and cents into pounds,

1. *Ante*, p. 378.

shillings and pence, figure his interest and convert the result back into dollars and cents.

However, our conception of a dime is as definite as the Englishman's is of a sixpence. The reason why inches, feet and miles seem more definite to us than centimeters, meters and kilometers, is simply that we are used to them, and with equal experience the metric units become just as definite, and are, from the start, far more convenient.

The metric system was first suggested to the French by the success and convenience of our decimal system of coinage, and is now in use in every civilized country in the world, and is the prevailing system in every cizilized country, except England, the United States, Russia and Denmark. The foreign commerce of Russia and Denmark is carried on chiefly, if not wholly, in the metric system, and probably half of the foreign commerce in England and here. The very paper in which Mr. Porter's letter appeared deals chiefly with the metric system, for it is the native tongue of electricity.

Nearly all scientific work in every country on the globe is done in this system, and the most advanced and able engineers in this country are taking it up. The Merrimac Mills, the Solvay Process Company and the Waltham Watch Company have adopted it. The head of the Lowell (Mass.) Textile School made a special trip to Washington to plead its adoption, for the immense advantage by simplifying the present intricate and tedious calculations in spinning and weaving. The only formal plea against it, on the part of the manufacturer, at the recent hearing, was made by a great and progressive firm, who are selling great quantities of machines abroad built on the metric system.

It was plain that they had found it such a good thing they wanted to keep it to themselves. There is far greater danger of confusing feet and inches in ordering and erecting iron and steel than that of misplacing a decimal point. Your typewriter is always putting one stroke for two, or vice versa, or the two strokes that signify inches may be blurred and look like one. The mechanical engineer must now carry in his head, or in his pocket, a vast number of inexact equivalents. For instance: 7.48 gallons = 1 cubic foot; 8⅓ pounds = one gallon of water; 62½ pounds of water = 1 cubic foot. If he is building a grain elevator his quart is one size, if a linseed oil vat it is another, and in neither case based on the foot rule with which he builds.

If he is planning a railroad he must remember that 5½ yards make a rod, perch or pole, and that there are 5,280 feet in a mile, and 7 9/10 inches in the links of a surveyor's chain. If he is building a tank for petroleum he must remember that a barrel means 42 gallons; but if he buys a barrel of petroleum he will receive from 49 to 52 gallons, and if he buys 100 barrels he does not know what he is going to get. If he fills his vat with linseed oil it will be billed to him as so many gallons, but he will find he has less than he paid for, for linseed oil is weighed, and so many pounds charged as a gallon.

He figures on a coal bin and finds that it is 10 per cent. too small, because a ton of anthracite is 2,240 pounds. The next coal bin he builds is 10 per cent. too large, because bituminous is figured at 2,000 pounds to the ton. He buys pipe, which is sold according to the nominal internal diameter, and finds that a ¼-inch pipe will carry more than 4 times as much water or gas as he had figured, or because its actual diameter is twice the nominal. One chief argument against the metric system for us is that the English have not yet adopted it, but it is dollars to doughnuts that they would soon follow our lead. They recently sent a circular letter to their representatives in the various countries that have adopted this system asking whether it was liked; how it was introduced; and what was its effect on domestic and foreign trade? All of their answers were favorable to the metric system. Suppose they do not adopt it, they are now carrying on more than half of their foreign commerce with the 450,000,000 of people that are using the metric system, and we should be far less likely to have misunderstandings and disputes than as at present. Measures and weights in the metric system are the same the world over, and never have meant anything else; but, before its introduction there were more different standards of weight known as a pound or its equivalent than there are members of the United States Senate, Supreme Court, President and Cabinet twice over.

The English have one ton, we another.
" " " " cwt., " "
" " " " quarter, we another.
" " " three different barrels; we two or three others.
" " " three different gallons; we another.
" " " three different threads from ours, both for pipe and for bolts.

We have now two miles, two pounds, two ounces, two quarts, two tons, three or four different barrels, and many minor complications.

In short, the general situation is this. We are using two systems: one of them is in use in every civilized country, and is the prevailing system in every country of the civilized world except the United States, England, Russia and Denmark.

It is even in these countries the system used in scientific research, and the only system allowed in medicine and pharmacy in Russia.

The other is inexact and only used in two countries, and not uniformly even there. In the metric system conversion of one denomination into another is simply moving a decimal point. The liquid and the dry measures are the same. There is only one system of weights.

The mechanical engineer, the business man, the contractor and builder can convert length into area, and dry or liquid measure without any arbitrary or inexact multiples. It gives incomparably greater uniformity and absoluteness of definition than have otherwise ever been attained.

It gives (and is the only system that gives) either convenient or accurate interchangeability of all linear, superficial, and cubical measure. It is the system in use in our recently acquired colonies. It is now used, to a considerable extent, in every State in the Union. Its universal adoption would remove a potent obstacle to our foreign trade.

Shall we long tolerate two systems in our own territory? Shall we retrograde and deprive our colonies of the good systems left them by poor old Spain; or shall we advance?

We shall advance, and the only real question is, "When and how?"

As to when, 2½ years proved amply sufficient for Germany and Austria. Are we less progressive? As to how, we can safely be guided by the experience of our predecessors. We should provide an adequate supply of the various standards, systematically educate the community in the new measures and enact mild penalties for use of the old in trade and commerce after a certain date.

An Experience in Canvassing.[1]

By F. W. Cross, Assoc. M. Inst. C.E., Engineer and Manager of the Lea Bridge District Gas Company.

In response to the suggestion in the leaderette on "Exhibitions and Interviewing," in last week's issue of the *Journal*—that it would be interesting if gas managers who have tried the system of interviewing consumers would communicate their experiences—the writer may say that early last year, at the instance of one of his Directors, he turned his thoughts to the making of a thorough canvass of the Company's district, purely with the object of increasing the use of gas cookers.

The following working notes were then drawn up for consideration:

Canvass.—It is proposed to employ two canvassers, supplied by, and at the cost of, the stove manufacturers, under the sole control and direction of the Company's Engineer. To avoid undue influence being exercised simply to obtain orders, the Company's inspector will in all cases call on the intending consumer to take the definite order.

Hire Purchase.—Special inducement of 20 to 25 per cent. off list prices to those taking stoves on the hire-purchase system.

Charges.—The Company now charge for any extra length of service to meter over 30 feet from the main, with a fixed charge for the connections and fixing of meter according to size, and for any extra length of service to cooker over 20 feet from meter. It is now proposed to extend the lengths of the services to 60 and 40 feet respectively, retaining the fixed charges for the meters. This alteration will meet all ordinary cases, and will remove one of the greatest sources of grumbling by intending consumers. The retention of the meter charges will to a very great extent prevent the Company being imposed upon by what may be termed "short service" customers, and also act as a deterrent to undue influence on the part of the canvassers.

Rental of Stoves.—To remain as at present, ranging from 2s. 6d. to 4s. 6d. per quarter, and giving a return of just over 12 per cent. on the net cost of the stove. One of our conditions is that the consumer agrees to rent the stove for a period of not less than 12 months from the date of fixing. As a fact, we get very few stoves returned except by people changing residences, or leaving the district.

Slot Meters.—Where it is desirable, where requested, or where objection is made to the Company's charges, it is proposed to fix 1s. slot meters; the rental of meter and stove being charged for with the gas. In no case is it proposed to fix fittings.

Show Rooms.—During the period of canvass, it is proposed to rent shops in different parts of the district, in which a show of stoves can be placed. The canvassers would work from these show rooms, and get intending consumers to call and see the stoves. The Company to bear

1. *Journal of Gas Lighting*

the expense of the show room; and the stovemakers to supply a cook and show stoves in operation.

From these notes, the working conditions for a systematic canvass of the Company's district were ultimately developed, and took the form of an agreement between the Company and the stove manufacturers.

The agreement was in the following terms:

LEA BRIDGE DISTRICT GAS COMPANY.

Proposing Canvassing for Stove Business. Conditions agreed upon between the Company's Engineer and Representatives of Messrs. Fletcher, Russell & Co., and Messrs. Richmond & Co.

Canvassers.—It is proposed to employ 2 canvassers, supplied by and at the cost equally of Messrs. Fletcher, Russell & Co., and Messrs Richmond & Co.; each canvasser to be approved of, and be under the sole control and direction of the Company's Engineer.

The main object to be observed by each canvasser is to obtain genuine business; and he is therefore to exercise a wise discretion as to where he may call and in all his dealings with intending consumers, looking for guidance in this respect to the engineer or the Company's officials.

Each canvasser will be provided with a directory of the district, in which the streets he will canvass will be indicated, and in which present consumers, and those already provided with cookers will be indicated.

Each canvasser will advise his calling by post; then call. Try persuasion, and give full advice. Leave circulars and forms, with cards to be sent to the Engineer, requesting Inspector to call.

Numbered application forms to be furnished to canvassers, but not to be used for indiscriminate distribution. A strict return of the distribution of these forms to be made to the Engineer.

No order will be accepted by the Company until the Inspector has called to verify same.

The condition contained in the agreement form, that the consumer "agrees to rent the cooker for a period of 12 months from the date of fixing," must in all cases be clearly pointed out as one of the conditions of supply.

Each canvasser shall daily submit a full written report to the Company's Engineer of the work done, and at least once a week shall discuss these reports with the Engineer.

The canvassers are not authorized to receive any moneys on behalf of the Company.

Pamphlets and Circulars.—The Company will provide advice notes, introduction cards, cooker pamphlets with conditions of supply, and application forms. No other circulars to be used except by consent of the Company's Engineer.

Concessions by Company.—The Company have amended their regulations as to supply, reducing the charge for services to meter and cooker by increasing the length of service laid free of charge from 30 feet to 60 feet, and from 20 feet to 40 feet respectively, but retaining the fixing charges for meter.

They are also prepared to fix shilling slot meters with cookers in special cases; but this business is not to be forced. It is simply to be used as an inducement where it is impossible to obtain an order for supply by ordinary meter.

Penny slot meters will not under any circumstances be supplied, neither will fittings be supplied, except by special arrangement made direct with the Company's Engineer.

Impartiality of Canvass.—It is a condition of this canvass that the canvassers are to work directly on behalf of the Company; and they are therefore to be absolutely and strictly impartial in their recommendations; their objects being to place a cooker independently of which particular make the cooker may be, and no secret arrangement is to be made between either of the firms and the canvasser.

The firms having mutually arranged the terms and commission to be paid to the canvassers, the commission is to be paid by the respective firms upon all orders for stoves of their manufacture independent of through which canvasser the order is obtained.

No order to be considered genuine until certified by the Company's Engineer.

Undue Influence.—Each canvasser is to be cautioned against using any undue influence in recommending a particular maker's cooker; and what is to be considered undue influence is to be left entirely to the discretion of the Company's Engineer.

In the event of any undue influence being exercised: For the first offence, the canvasser will be cautioned; for the second offence, his firm will be notified and cautioned; for the third offence, the canvasser will be removed, and his firm will not be allowed to take any further part in the canvass.

The Engineer's opinion shall in all matters of difference between any of the parties concerned in this work be absolutely final.

Show-Rooms.—If possible, it is proposed to open a show room, or show rooms, central to the whole district, or central to the districts to be canvassed from time to time.

The Company will bear the expense of the show room, and provide an assistant, fittings and gas.

The firms will mutually provide a show of stoves in equal proportions, and, as may be mutually agreed upon, will provide a cook to show cookers in operation.

It was further arranged that all salary and commission payable to the canvassers should be paid through the Company's Engineer; a weekly statement of the amount being furnished to the stove makers, who refunded the amount to the Company. As a further inducement to the canvassers over and above their salary and commission on the stoves placed out, the Company offered them a commission upon every new ordinary consumer obtained directly through their agency; but, as the Company had no desire to force the use of slot meters, this commission was not to be paid upon new slot consumers.

A difficulty was found in obtaining shops suitable for show rooms in the various parts of the district, and a central show room was consequently opened. The writer is now of opinion that this is the better plan to adopt.

In the development of this canvass, it was anticipated that the following advantages could be claimed:

Reduction of charges would remove a great obstacle to the increase of business.

Canvassing would, without doubt, introduce a very large number of new consumers.

Consumers using cookers would burn more gas than ordinary consumers.

Consumers taking cookers in the first instance would, in many cases, ultimately use gas for lighting.

The greatest obstacle to the electric light is to get gas introduced into houses either for lighting or cooking.

Where electric light is introduced, the Company may retain the use of gas for cooking.

The result of the canvass was an ample justification of the advantages claimed.

The employment of canvassers commenced on April 29, 1900, and ceased at the end of September. The following figures will show the increase in the Company's business during the whole of the year 1900, subdivided into three periods—viz., before, during and after the canvass.

	Dec. 1900.	Dec. 1901.
Consumers	2,623	3,223
Cookers	546	1,039

1901.	Ordinary Consumers.	Slot Consumers.	Cookers.
Up to April 30	71	2	37
" Aug. 31	153	131	315
" Dec. 31	140	103	141

In conclusion, and to give credit where credit was due, the stove makers employed were Messrs. Fletcher, Russell, & Co., and Messrs. Richmond & Co.; and the writer would desire to express his gratitude to both these firms and to their representatives for their co-operation and the strictly honorable manner in which they worked together to make the canvass a success, and to carry out all the terms of the arrangements made between them and the Gas Company. The results were considered so satisfactory that the canvass will be repeated in 1902.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Western Gas Construction Company, of Fort Wayne, Ind., has been awarded a contract for the installing of a double superheater water gas set in the plant of the Belleville (Ills.) Gas Light and Coke Company. The generating capacity is put at 250,000 cubic feet per day. The contract includes an exhauster and other necessary apparatus.

MR. T. H STUART, Secretary of the Southwestern Gas, Electric and Street Railway Association, is responsible for the following circular letter which has been well distributed to those concerned in the industries which the Association represents in the district that it covers:

"This letter is about the Southwestern Gas, Electric and Street Railway Association, which is called to meet in fourth annual session in San Antonio, Texas, April 18 to 21, 1902. The writer has no apologies to make if this letter appears to be rather long, as the subject deals particularly with a matter in which you should be deeply interested, and we feel that we have a right to ask you to read it through and deliberate on it awhile, and then, if you are a member of the Association, go to talking up the meeting, if you are not, send in your application for membership, in the meantime 'talking up' the meeting anyway. This is the age of Associations. The day is past when man dies and has buried with him the key to his profession or business. The age of Associations and associate work is here not only to perpetuate but to enlarge on the already accumulated knowledge of the past, and to benefit every honest seeker after knowledge. It is through association with other men and the interchange of ideas and experience that men are made broad and comprehensive, and every honest man will spare no means to glean from every honorable source the knowledge that is necessary to best fit him for the accomplishment of the work which he has engaged to carry out. The whole fabric of civilization is woven from association and mutual help, and it is but right and natural that we should each help the other. Four years ago some very wise and especially un-

selfish members of the gas and electric fraternity conceived this idea, and organized the Southwestern Gas, Electric and Street Railway Association. To say that their efforts have been marked with success is but to call attention to the Association to-day, which stands no longer in the experimental state but a startling reality in our midst, ranking amongst the oldest Associations of the country, and each year proves more conclusively the benefits to be derived and the results that follow coming together for a few days to pool information and experience and to discuss the same with a view to deducting the proper conclusions. To those who have attended the meetings, this letter is unnecessary, and it is therefore intended particularly to remind those who have not attended the meetings of the many benefits in store for them, and to urge them to test those benefits by attending the April meeting at San Antonio, thus satisfying themselves, and at the same time lending their presence and influence to an enterprise which justly deserves support. Don't forget the dates of the meeting and try to be on hand or send a representative."

THE Iroquois Machine Company has just been incorporated as a New York Company, having been organized by Mr. W. W. Gibbs. The officers are: President, Edwin A. Smith, Providence, R. I.; Vice-President and General Manager, W. W. Gibbs, New York city; Secretary and Treasurer, Henry C. Babcock, Providence, R. I. The principal offices will be in 150 Nassau street, New York city. The Company's main output will be improved iron drawing machinery, but it will also manufacture a full line of automatic and plain drop hammers, swaging machines, grinding machines, roller bearings, etc. The factories are to be located in the old plant of the Universal Machine Company, Providence, R. I., the equipment of which has been so changed and improved as to fully meet the needs of its new owners.

THE aggregate daily output capacity of contracts awarded the United Gas Improvement Company so far this year, for its standard, double superheater Lowe water gas apparatus is about 14,500,000 cubic feet. Amongst the points in which the installations will be made are: Atlantic City, N. J.; Brooklyn (N. Y.) Union Gas Company; Champaign, Ills.; Dallas, Tex.; Danville, Ills.; Des Moines, Iowa; Houston, Tex.; Indianapolis, Ind.; Jersey City, N. J.; Laconia, N. H.; La Salle-Peru, Ills.; Newark, N. J.; New Orleans, La.; Norfolk, Va.; Portland, Me.; Suffern, N. Y.

MAYOR SIMPSON, of Alexandria, Va., has signed the ordinance asking the legislature for authority to issue $50,000 four per cent. "public improvement bonds." A portion of the sum to be thus raised is to be devoted to repairs on and extensions to the city gas plant.

THE proprietors of the Citizen's Gas Company, of Kankakee, Ills., have determined to construct a new retort house, a purifying system, and storage holder rated to contain 100,000 cubic feet. Notable additions to the distributing service have also been arranged for.

THE Legislature of Kentucky has passed the bill enabling the city to sell the stock which it holds for public account in the shares of the Louisville (Ky.) Gas Company.

THE Bridgeport (Conn.) Gas Light Company has discontinued the sale of fuel gas, formerly supplied through the mains of the defunct Citizens Gas Light Company, at the rate of 50 cents per 1,000 cubic feet.

CAPTAIN WILLIAM H. WHITE has been awarded the contract for the construction of the gas and electric lighting plants and the power house for traction purposes which the proprietors of the Citizens Light and Power Company propose to construct and operate in Auburn, N. Y.

A CORRESPONDENT forwards the following from Covington, Ky., under date of the 15th inst;: "Judge Tarvin recently handed down an important decision in the Covington gas case the sense of which is like this: 'Suit was instituted some time ago by the city of Covington to recover franchise taxes from the Covington Gas Light Company for the years 1899, 1900 and 1901. The value of the franchise is arrived at by taking the difference between the value of the capital stock and the tangible property. The assessment on the machinery was $25,000, but the Company claimed it was worth $122,500. Under an ordinance passed by the City Council some time ago machinery is exempted from taxation for a period of 5 years. Under this rule an increase in the valuation of the machinery would work a decrease in the value of the franchise and a consequent decrease in the taxation thereof. It was claimed by the Company that, as it had sold out its business, it had no franchise and that the act of 1898, empowering the City Assessor to make the assessment on the franchise, instead of the State Board of Equalization, was illegal. Judge Tarvin held that the Company had a franchise assessable by the city, and that, as the act of 1898 was not a violation of the Constitution, therefore the assessment under it is legal. He further held that the capital stock for valuation purposes on tax account was $340,000, but that the value of the machinery should be placed at $122,500, as claimed by the Company.'"

THE Western Gas Construction Company, of Fort Wayne, Ind., will construct the gas plant that is to be erected in Dowagiae, Mich., this spring. It is to be of the coal gas type.

THE committee of the Board of Supervisors appointed to consider the advisability of establishing a plant for the lighting and heating of the Court House and County Jail of Westchester County, N. Y., submitted an adverse report on the proposition.

THE Board of City Trustees of Vallejo. Cal., recently decreed that the maximum rate that may be charged by any person or corporation furnishing electric light to the residents shall not exceed 12 cents per 1,000 watts, but that 75 cents shall be the minimum charge for lighting any one place for each month. Section 2 of the ordinance further provides that "Consumers having agreed with any person or corporation to use 4, 6, 8, 16, 24 or larger candle power lamp, shall not substitute larger candle power lamp, without first notifying said person or corporation, and said person or corporation agreeing thereto, and the said Company may charge for the difference of the power substituted without permission. No fee shall be charged for the inspection of wiring on any premises by said firm or corporation."

THE Board also declared that, on and after July 1st, 1902, "The maximum rate that may be charged by any person or corporation furnishing gas to the citizens of Vallejo shall be $2.50 per 1,000 cubic feet."

THE International Lighting and Appliance Company, of Baltimore, Md., with a capital of $250,000, to furnish gas for lighting and heating purposes, has been incorporated in Dover, Del.

MR. W. H. CLELAND has been appointed City Gas Inspector for Kansas City, Mo., vice Mr. William O. Brem.

COLONEL BENJAMIN BROOKE, President of the Media (Pa.) Gas Company, died at his home in Media the morning of the 12th inst. Deceased, who was in his 62d year, served with distinction through the War of the Rebellion. At the time of his death he was President of the First National Bank of Media, and was also prominently identified with substantial business of Media other than those named.

THE friends of Mr. A. B. Johnson, General Manager of the Equitable Gas and Electric Company, of Utica, N. Y., will rejoice in the knowledge that the operation recently performed upon him has resulted in the complete fulfillment of the hopes of the surgeons who conducted it.

AT the annual meeting of the Hudson County (N. J.) Gas Company the stockholders had every reason to be satisfied with the working results of the corporation for the year, as the following extracts from the report of the President (Mr. E. F. C. Young) go to prove: Increase in gas sales over previous year, 18.2 per cent.; increase in meters, 5,814; services run during the year, 2,636; gas appliances of all kinds installed during the year, 7,237; Welsbach lamps placed during the year, 5,774; gas engines installed, 44; street mains laid in the twelvemonth, 26.64 miles. The net profits for the year, after payment of all interest and fixed charges, were $115,008.22. The officers chosen were: Directors, E. F. C. Young, Cornelius Zabriskie, H. Wallis, J. E. Hulshizer, T. H. Williams, J. D. Bedle, Randal Morgan, A. P. Hexamer, W. C. Heppenheimer, Elbert Rappleye, S. B. Dod, Myles Tierney, P. F. Wanser, E. L. Young and M. T. Cox; President, E. F. C. Young; Vice-President, Walton Clark; Treasurer, Lewis Lillie; Asst. Treasurer and Secretary, Percy S. Young; Asst. Secretary, R, D. Miller.

AT a recent meeting of the Board of Directors of the Rochester (N. Y.) Gas and Electric Company the following action was taken:

"Resolved, That on and after October 1, 1902, the price of illuminating gas to consumers be fixed at $1.30 per 1,000 cubic feet, with a discount of 20 cents per 1,000 cubic feet on bills paid on or before the 10th of the month; and that on and after April 1, 1903, the price of illuminating and fuel gas be fixed at $1.20 per 1,000 cubic feet, with a discount of 20 cents per 1,000 cubic feet on bills paid on or before the 10th of the month; the quality of the gas to be not less than 20-candle power."

THE water gas addition to the plant of the Houston (Texas) Company is in satisfactory operation.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

MONDAY, MARCH 24, 1902.

The Market for Gas Securities.

There was a decided scramble for Consolidated early in the week, which sent the price thereof above 227, and the movement was undoubtedly inspired by the belief that there was something positive going on in connection with the long talked of merger with the Brooklyn Union Company. That much of the trading was on speculative or manipulative account was shown in a quick shrinkage, for sales on profit taking score caused quite an erratic market, the closing for the week (Friday) being made at 223¾ to 224.

Brooklyn Union once more crossed Consolidated in value during the week. It sold a fraction over 228, and the rise, of course, was prompted by the rumors regarding the actual approach of an agreement for consolidation. It closed to-day at 222 to 224. The real "sensation" of the week, however, was a spurt in Bay State, which "brought it over one!" It has not been at such figure for many a day. Baltimore Consolidated is up to 68-69, and it will go higher. Washington gas is again well over the 400 mark. Indianapolis stock and bonds made a quick gain, and the indications respecting the Company are that confidence in its future has been restored.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

MARCH 24.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	223¾	224
Central Union, Bonds, 5's.	3,000,000	1,000	110	111½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	310	325
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000	111½	..
Northern Union, Bonds, 5's.	1,250,000	1,000	106	108
New York and East River.. Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000	..	109	111
Richmond Co., S. I.	348,650	50	100	..
" Bonds	100,000	1,000	103	..
Standard	5,000,000	100	130	140
Preferred	5,000,000	100	150	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	118	..
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	222	224
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	1	1¼
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works..	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust..	7,000,000	1,000	82	85
2d " " " ..	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	10½	11½
" " Bonds, 5's	5,250,000	1,000	79	80½
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co..	29,500,000	100	101¾	102
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	68½	69
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	13	14
" Con. Mtg. 5's	380,000	1,000	80	81
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50		89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	852,000	1,000	70	73
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	..	.
" Bonds	2,000,000	..	53	55
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	102	104
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	70	.
" Bonds, 6's	2 650,000	..	103	104½
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	200,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	.	90
Preferred	2,500,000	100	..	106
Bonds	10,000,000	1,000	..	108½
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	57	62
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	167½	170½
" 6 per cent. scrip, due 1910	100,000	25	25	87
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co Bonds, 6's	6,000,000	..	..	55
	4,600,000	..	..	103
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	102¾	103
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	48	48½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's.	650,000	1,000	113	116
Extension, 6's	600,000	1,000	113½	115
General Mortgage, 5's..	2,465,000	1,000	93	96
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	98	99
Syracuse, N. Y.	1,750,000	100	15	17
Bonds	1,612,000	1,000	95½	97½
Washington, D. C	2,600,000	20	405	407
First mortgage 6's	600,000	..	..	..
Western, Milwaukee. Bonds, 5's	4,000,000	..	106½	108
Wilmington, Del	600,000	50	232	..

Advertisers' Index.

GAS ENGINEERS. Page

Wm. Henry White, New York City ... 439
Fred. Bredel, Milwaukee, Wis. ... 426
Geo. R. Rowland, New York City ... 436
The Western Gas Construction Co., Fort Wayne, Ind. ... 444
Humphreys & Glasgow, New York City ... 437
David Leavitt Hough, New York City ... 436
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 433
Baxter & Young, Detroit, Mich ... 436
United Gas Improvement Co., Phila., Pa ... 431
James T. Lynn, Detroit, Mich ... 436
A. E. Boardman, Brevard, N. C ... 436
The Jeffrey Manufacturing Co., Columbus, O. ... 434

GAS WORKS APPARATUS AND CONSTRUCTION.

Continental Iron Works, Brooklyn, N. Y. ... 438
Deily & Fowler, Phila., Pa ... 440
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 436
Stacey Mfg. Co., Cincinnati, Ohio ... 439
Bartlett, Hayward & Co., Baltimore, Md ... 437
Davis and Farnum Mfg. Co., Waltham, Mass. ... 436
R. D. Wood & Co., Phila., Pa ... 438
Isbell-Porter Company, New York City ... 428
Fred. Bredel, Milwaukee, Wis ... 426
United Gas Improvement Co., Phila., Pa ... 431
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 433
The Western Gas Construction Co., Fort Wayne, Ind. ... 444
Humphreys & Glasgow, New York City ... 437
Logan Iron Works, Brooklyn, N. Y. ... 440
Riter-Conley Mfg. Co., Pittsburgh, Pa ... 439
Baxter & Young, Detroit, Mich ... 436
G. Shepard Page's Sons, New York City ... 436
James T. Lynn, Detroit, Mich ... 426
A. E. Boardman, Brevard, N. C ... 436
Christopher Cunningham, Brooklyn, N. Y. ... 424
The Jeffrey Manufacturing Co., Columbus, O. ... 434
Quintard Iron Works, New York City ... 433
The Connersville Blower Company, Connersville, Ind. ... 441
Lloyd Construction Co., Detroit, Mich ... 426

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md ... 437
United Gas Improvement Co., Phila., Pa ... 431
Burdett Loomis, Hartford, Conn ... 438
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 433
The Western Gas Construction Co., Fort Wayne, Ind. ... 444
Humphreys & Glasgow, New York City ... 437
B. E. Chollar, St. Louis, Mo ... 433

SCRUBBERS AND CONDENSERS.

R. D. Wood & Co., Phila., Pa ... 438
Continental Iron Works, Brooklyn, N. Y. ... 438
Logan Iron Works, Brooklyn, N. Y. ... 440
Riter-Conley Mfg. Co., Pittsburgh, Pa ... 439
The Western Gas Construction Co., Fort Wayne, Ind. ... 444

TAR AND CARBONIC ACID EXTRACTOR.

The Western Gas Construction Co., Fort Wayne, Ind. ... 444

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich ... 424
The Western Gas Construction Co., Fort Wayne, Ind. ... 444

GAS METERS.

John J. Griffin & Co., Phila., Pa ... 404
American Meter Co., New York and Philadelphia ... 443
Helme & McIlhenny, Phila., Pa ... 443
D. McDonald & Co., Albany, N.Y. ... 441
Nathaniel Tufts Meter Co., Boston, Mass. ... 442
Maryland Meter and Mfg. Co., Baltimore, Md ... 442
Metric Metal Co., Erie, Pa ... 443
Keystone Meter Co., Royersford, Pa ... 443
Detroit Meter Company, Detroit, Mich ... 443

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia ... 443
John J. Griffin & Co., Phila., Pa ... 404
D. McDonald & Co., Albany, N. Y. ... 441
Helme & McIlhenny, Phila., Pa ... 443
Nathaniel Tufts Meter Co., Boston, Mass. ... 442
Keystone Meter Co., Royersford, Pa ... 442

GAS AND WATER PIPES.

M. J. Drummond & Co., New York City ... 428
R. D. Wood & Co., Phila., Pa ... 438
Warren Foundry and Machine Co., New York City ... 428
Donaldson Iron Co., Emaus, Pa ... 428
Christopher Cunningham, Brooklyn, N. Y. ... 424
Charles Millar & Son Co., Utica, N. Y. ... 428

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N. Y. City ... 428

GAS TAPPING MACHINES.

George Light, Dayton, O. ... 428
H. Mueller Manufacturing Company, Decatur, Ills. ... 424

GAS COALS.

Perkins & Co., New York City ... 434
Westmoreland Coal Co., Phila., Pa ... 433
Berwind-White Coal Mining Co., New York and Phila. ... 434

CANNEL COALS.

Perkins & Co., New York City ... 434

CONVEYORS.

The Link-Belt Machinery Co., Chicago, Ills. ... 435
The Western Gas Construction Co., Fort Wayne, Ind. ... 444
The Jeffrey Manufacturing Co., Columbus, O. ... 434

GAS ENRICHERS.

Standard Oil Co., New York City ... 395
The Sun Oil Co., Pittsburgh, Pa ... 435

COKE CRUSHERS.

C. M. Keller, Columbus, Ind. ... 435
The Jeffrey Manufacturing Co., Columbus, O. ... 434

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y. ... 428
The Connersville Blower Company, Connersville, Ind. ... 441

ECONOMIZERS.

Green Fuel Ecanomizer Co., Matteawan, N. Y. ... 423

GAS GAUGES.
The Bristol Co., Waterbury, Conn..... 434

GAS GOVERNORS.
Connelly Iron Sponge and Governor Co., New York City 427
Isbell-Porter Co., New York City..... 438
R. D. Wood & Co., Phila., Pa..... 438

CEMENTS.
C. L. Gerould, Galesburg, Ills 432

RETORTS AND FIREBRICKS.
J. H. Gautier & Co., Jersey City, N. J..... 432
Adam Weber Sons, New York City..... 432
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 432
Cyrus Borgner, Phila., Pa..... 432
James Gardner, Jr., Co., Pittsburgh, Pa..... 432
Henry Maurer & Son, New York City..... 432
Baltimore Retort and Firebrick Co., Baltimore, Md..... 432
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 432
Brooklyn Firebrick Works, Brooklyn, N. Y..... 432
Missouri Firebrick Co., St. Louis, Mo..... 432

REGENERATIVE FURNACES.
Bartlett, Hayward & Co., Baltimore, Md..... 437
Fred. Bredel, Milwaukee, Wis..... 426
J. H. Gautier & Co., Jersey City, N. J..... 432
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 432
Adam Weber Sons, New York City..... 432
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 432
Missouri Firebrick Co., St. Louis, Mo..... 432
S. D. Merton & Co., St. Louis, Mo..... 432

SELF-SEALING MOUTHPIECE DOORS.
Isbell-Porter Co., New York City..... 438
Continental Iron Works, Brooklyn, N.Y..... 438
Logan Iron Works, Brooklyn, N. Y..... 440
R. D. Wood & Co., Phila., Pa..... 438
The Western Gas Construction Co., Fort Wayne, Ind... 444

CHIMNEY CONSTRUCTION.
Adam Weber Sons, New York City..... 432

INCANDESCENT GAS LAMPS.
Welsbach Company, Gloucester, N.J..... 430
General Gas Light Company, Kalamazoo, Mich..... 423
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 425

BURNERS.
C. A. Gefrorer, Phila., Pa..... 423
Wm. M. Crane Co., New York City..... 423
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 425

LAVA GAS TIPS.
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 425

STREET LAMPS.
Welsbach Street Lighting Co., New York and Phila..... 430
Thos. T. W. Miner, New York City..... 422

PURIFIERS.
R. D. Wood & Co., Phila., Pa..... 438
Stacey Mfg. Co., Cincinnati, O..... 433
The Western Gas Construction Co., Fort Wayne, Ind... 444

PURIFYING MATERIALS.
Connelly Iron Sponge and Governor Co., New York City 427

VALVES.
Ludlow Valve Manufacturing Co., Troy, N.Y..... 424
R. D. Wood & Co., Phila., Pa..... 438
Continental Iron Works, Brooklyn, N. Y..... 438
The P. H. & F. M. Roots Co., Connersville, Ind..... 397
Isbell-Porter Co., New York City..... 438
The Western Gas Construction Co., Fort Wayne, Ind.... 444
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 436

EXHAUSTERS.
The P. H. & F. M. Roots Co., Connersville, Ind..... 387
Isbell-Porter Company, New York City..... 438
Connelly Iron Sponge and Governor Co., New York City 427
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 436
The Connersville Blower Company, Connersville, Ind... 441

ELECTRICAL APPARATUS.
Wm. Henry White, New York City..... 430

ENGINES AND BOILERS.
The Hazelton Boiler Company, New York City..... 424

PURIFIER SCREENS.
John Cabot, New York City..... 434

GAS STOVES.
American Meter Co., New York and Philadelphia..... 429
Maryland Meter and Manufacturing Co., Baltimore, Md. 442
Keystone Meter Co., Royersford, Pa..... 442
Nathaniel Tufts Meter Co., Boston Mass..... 442

HOT WATER HEATERS.
The Humphrey Mfg. and Plating Co., Kalamazoo, Mich. 423

GASHOLDER TANKS.
J. P. Whittier, Brooklyn, N. Y..... 426

GASHOLDERS.
Bartlett, Hayward & Co., Baltimore, Md..... 437
Continental Iron Works, Brooklyn, N. Y..... 438
Delly & Fowler, Philadelphia, Pa..... 440
Davis & Farnum Mfg. Co., Waltham, Mass..... 436
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 436
Stacey Mfg. Co., Cincinnati, Ohio..... 439
R. D. Wood & Co., Philadelphia, Pa..... 438
Logan Iron Works, Brooklyn, N Y..... 440
Riter-Conley Mfg. Co., Pittsburgh, Pa..... 439

STORAGE TANKS.
Christopher Cunningham, Brooklyn, N. Y..... 424

AUDITORS AND ACCOUNTANTS.
The J. Dobson Good Audit Company, New York City.... 422

INVESTORS.
W. R. Faben Construction Company, Toledo, O.. 423

STOCKHOLDERS' MEETING.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., March 1, 1902.

The Annual Meeting of the Stockholders of the United Gas Improvement Company will be held at the office of the Company, northwest corner of BROAD AND ARCH STS., PHILADELPHIA, on Monday, May 5, 1902, at 12 o'clock, noon, for the purposes of electing a President and six Directors, to serve for the ensuing year, considering and acting upon the subject of a proposed increase in the capital stock of the Company from 450,000 shares, of the par value of $50 each, to 565,000 shares, of the par value of $50 each, and transacting such other business as may properly come before the meeting.

The stock transfer books will be closed from 3 P.M , April 29, until 9 A.M., May 6th.

By order of the Board of Directors,

1396-4-e.o.t LEWIS LILLIE, Secretary.

DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., March 12, 1902.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable April 15th, 1902, to stockholders of record at the close of business, March 31, 1902. Checks will be mailed.

1397-5 LEWIS LILLIE, Treasurer.

WANTED,

Position as Manager or Superintendent,

By an energetic man, having had a large experience in the manufacture and distribution of both coal and water gas. Fully competent to supervise all improvements and extensions. A1 references. Address, "W. J. V.,"

1398-2 Care this Journal.

Position Wanted.

Steady Young Man wishes Employment.

Has had six years' experience in gas works. Used to main and service laying, gasfitting, meter setting and complaint work. Also handy at draughting. Best of references.

1398-1 Address "R. W.," care this Journal.

WANTED.

A Steady Young Man Wishes Employment as Gasfitter.

Has had first-class experience with gas company in house piping, connecting gas stoves, gas water-heaters, meter setting, meter reading and complaint work. Handy at draughting. Best of references. Address, "H. M.,"

1398-1 Care this Journal.

Position Desired

By a Practical Gas and Electric Engineer.

In present position for the past 10 years. Good reasons for making change. Fourteen years in the business. Has reconstructed several plants. A practical office man, as well as being competent to lay out extensions and new work that owners of plants may contemplate. References exchanged.

1398-4 Address, "PROGRESSIVE," care this Journal.

Position Wanted.

A practical young man, who has been in the gas business the greater part of his life, and who thoroughly understands the manufacturing and distributing divisions of a gas works, desires a position. Can do anything required inside or outside of a gas plant. Best of references.

Address, "ST. J.,"

1398-1 Care this Journal

Position Wanted

As Assistant Superintendent or General Foreman.

A young man, who has had two years' experience in the manufacture of coal and water gas, wishes a position as assistant superintendent or general foreman.

Address, "ASSISTANT,"

1397-2 Care this Journal.

WANTED,

A FOREMAN.

A young man, of good experience in coal and water gas, to take position as foreman in Western city of 40,000 population.

Address, "L.,"

1397-2 Care this Journal.

FOREMEN WANTED.

Four experienced men as foremen of service gangs. Steady work for competent men. Apply by letter, stating experience and wages expected.

Address, MILWAUKEE GAS LIGHT COMPANY,

1397-2 Milwaukee, Wis.

WANTED,

Second-Hand Apparatus, as follows:

4 Purifier Boxes, about 8 feet by 8 feet by 2½ feet.
1 Five-foot Station Meter.
1 Set Water Gas Apparatus, 4 feet or 4½ feet.

Send full specifications, plans and price, with date of delivery. Address,

"STANDARD,"

1378-tf Care this Journal.

STREET LAMPS FOR SALE.

500 old-style square heads, $1.50 each.
500 No. 51 Miner heads, $2.50 each.
300 No. 29 globe boulevard heads, $3 50 each.
1,000 five-foot Wilder volumetric governors, 15 cents each.

Lamps will be crated and delivered on board cars in good order. Address,

MILWAUKEE GAS LIGHT CO.,

1395-4 MILWAUKEE, WIS.

INVENTIONS FOR EUROPE.

Engineers of standing and acquaintance in Europe are desirous of securing the handling of some good inventions abroad. We want such as will justify the organization of companies. Liberal propositions for the right articles.

ZERBE & ZERBE, Engineers,

1345-tf 11 Broadway, New York.

THE J. DOBSON GOOD AUDIT CO.,
PUBLIC ACCOUNTANTS AND AUDITORS.

Accounts of Mercantile Firms, Banks, Railroads, Gas and Electric Companies, Executors, Trustees, Assignees, Receivers and Corporations, thoroughly and confidentially examined and reported upon.

Special Books Planned & Opened for Gas & Electric Co's.

Telephone, 4345 Cortlandt. | Cable Address, "Bevel," New York. | **128 Broadway,** NEW YORK.

MRS. HELEN ARMSTRONG,

Teacher of Cookery.

Special Courses Prepared for Gas Companies.

159 West 66th Street, Chicago, Ills.

☞ Refers, by permission, to the following gas companies, for whom such lectures have been given:

NASHVILLE, TENN. MACON, GA.
SHREVEPORT, LA. KEOKUK, IA.
SALEM, O. NEWPORT NEWS, VA.
PENN YAN, N. Y. NEW YORK CITY.
NATIONAL GAS COMPANY, CHICAGO, ILLS.

"THE MINER"

Globe
Street and Boulevard
Lamps.

Cheapest and Best.

THOUSANDS IN USE WITH INCANDESCENT BURNERS.

Send for Catalogues.

THOMAS T. W. MINER,

821-823 Eagle Av., N.Y.

IN THE MARKET.

WE PURCHASE:

Gas properties,
Electric light properties.
Street railway properties.
Also desirable franchises.

W. R. FABEN CONSTRUCTION CO.,
1383-tf 317 St. Claire Street, Toledo, O.

GAS BURNERS,

To burn a given amount at a stated pressure, made to order. Samples furnished. Also, small oil and air valves, slow-feed valves for high pressure, and small brasswork in general.

Drip Pumps, Service Cleaners, Gasfitters' Proving Pumps and Mercury Gauges.

C. GEFRORER & SON,
218 North 8th Street, Philadelphia, Pa.

INCREASE SALE OF GAS

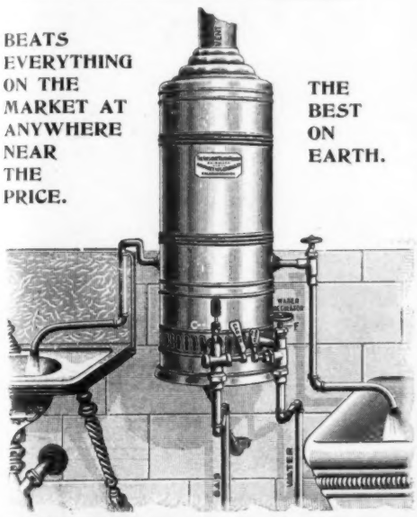
BY PUSHING THE

Humphrey Crescent Instantaneous Water Heaters.

This is our No. 8 Crescent Heater.

BEATS EVERYTHING ON THE MARKET AT ANYWHERE NEAR THE PRICE.

THE BEST ON EARTH.



List Price, Nickel Plated,

$20.00,

Including N. P. Shelf and Bracket.

Every Heater Guaranteed.

SEND FOR CATALOGUE AND PRICES.

Will send heater on 60 days' trial to any Gas Company.

The Humphrey Mfg. & Plating Co.,

FACTORY AND MAIN OFFICES:
KALAMAZOO, MICH., U. S. A.

BRAY BURNERS,

THE

STANDARD OF MERIT THE WORLD OVER.

Made for Low and High Pressure.
Forty Years' Experience.

WILLIAM M. CRANE CO.,

1131 AND 1133 BROADWAY, NEW YORK.

SOLE AGENTS FOR UNITED STATES.

THIS IS THE

HUMPHREY GAS ARC LIGHT,

The Best Light in the World

FOR LIGHTING

Stores, Churches, Halls or any large indoor areas.

Guaranteed to give a greater volume of light, better diffused and steadier than an electric arc.

A Complete Revolution in Gas Lighting.

A sample lamp sent on 30 days' trial to any Gas Company.

This lamp is thoroughly protected with both Mechanical and Design Patents. Imitation of this Design and Construction will be prosecuted.

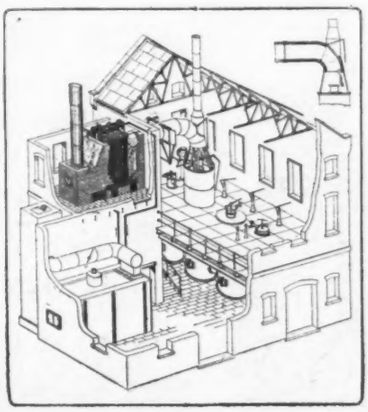
Manufactured by the General Gas Light Co.,

KALAMAZOO, MICH.

Economize Heat in Water Gas Plants,

BY UTILIZING A

Green's Economizer,



To absorb the heat now going to waste when you blow through your superheater to heat the feed water for your boilers to the temperature of the steam. This is now being done at the Poughkeepsie Gas Works, Poughkeepsie, N. Y. : : : : :

Write for full particulars how this is accomplished, the saving effected, and the advantages gained, to the

GREEN FUEL ECONOMIZER CO.,

MATTEAWAN, N. Y.

CHRISTOPHER CUNNINGHAM,

PROPRIETOR,

THE NOVELTY STEAM BOILER WORKS,

BROOKLYN, N. Y.

STORAGE TANKS FOR GAS WORKS,

To Retain Fluid Material of Any Sort.

PIPING IN AND AROUND GAS WORKS.

Work Done for Several of the Largest Gas Companies in America Stands as Reference.

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich.

Special Attachment, B-109.

AN INSURANCE POLICY.

TO any manager who is thinking of liability insurance, we would like to show this kind of a machine.

It is a safe machine to work with, your men are safe, and you have a good policy for their protection from asphyxia.

CATALOGUE OF MUELLER MACHINES FROM

H. MUELLER MFG. COMPANY,

DECATUR, ILLS.

HAZELTON WATER TUBE HIGH PRESSURE BOILERS.

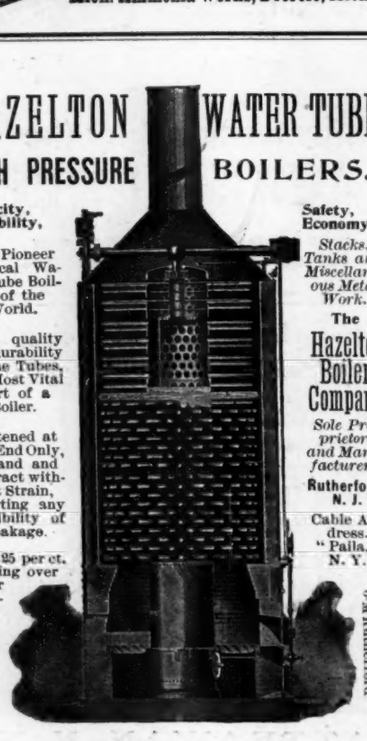
Capacity, Durability,

The Pioneer Vertical Water Tube Boiler of the World.

High quality and durability of the Tubes, the Most Vital Part of a Boiler.

Fastened at One End Only, expand and contract without Strain, Averting any Possibility of Leakage.

10 to 25 per ct. saving over other Boilers.



Safety, Economy.

Stacks, Tanks and Miscellaneous Metal Work.

The Hazelton Boiler Company

Sole Proprietors and Manufacturers,
Rutherford, N. J.

Cable Address. "Paila," N. Y.

Telephone, 6-M Rutherford

THE

Ludlow Valve Mfg. Co.,

TROY, N. Y., U. S. A.

Double and Single Gate Valves, ¼" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.

HOT GAS VALVES A SPECIALTY.

Send for Catalogue.

COME OVER THE BORDER—Into the Realm of GOOD BURNERS

THE BEST LAVA TIPS ARE STEWARD TIPS

STEWARD

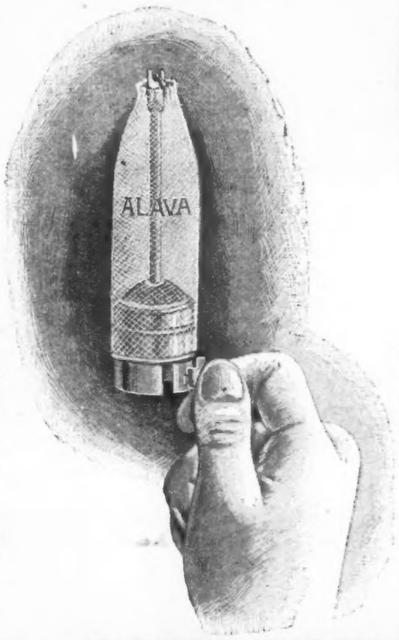
BURNERS.

Guaranteed the BEST Open-Light burner that money and skill can make.

SEND FOR SAMPLE.

NO CHARGE TO GAS COMPANIES

STRICTLY HIGH-CLASS LAVA TIPS.



"ALWAYS STAND UP STRAIGHT"

ALAVA

"ALWAYS STAND UP STRAIGHT"

ALAVA

CENTER-SUPPORT CAP MANTLE.

A BRILLIANT SUCCESS.

Gas men everywhere admit the correctness of the Center Support, and have given ALAVA the highest indorsement. SUBSTANTIAL INDORSEMENT in the shape of orders. If you haven't done so already it will pay YOU to investigate. Send for our booklet entitled "Center Supports." : : : : : : : : : : :

The D. M. Steward Mfg. Co.

GENERAL OFFICE AND WORKS:
CHATTANOOGA, TENN.
New York Office: 107 Chambers St.

STEWARD TIPS ARE THE BEST LAVA TIPS

The Realm of GOOD BURNERS is just OVER THE BORDER

SCIENTIFIC BOOKS.

GAS MANUFACTURE, THE CHEMISTRY OF, by W. J. A. Butterfield. $3.

NEWBIGGING'S HANDBOOK. By Thos. Newbigging. 6th edition. $6.

COX'S GAS FLOW COMPUTER. $2.50.

FIELD'S ANALYSIS, 1900. $5.

HUGHES' GAS WORKS. $1.65.

POOLE ON FUELS. By Herman Poole. $3.

GAS ENGINEER'S POCKET-BOOK. By Henry O'Connor $3.50.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards. 20 cents.

PRACTICAL TREATISE ON HEAT By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and Its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

HEMPEL'S GAS ANALYSIS, $2. (In press.)

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfeld. $1.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2.

PRACTICAL HINTS ON REGENERATOR FURNACES By M. Graham. $1.25.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

AMERICAN PLUMBING. By Alfred Revill. $2.

CEMENT; A Manual of Lime and Cement, their Treatment and Use in Construction. By A. H. Heath. $2.50.

A COMPARISON BETWEEN THE ENGLISH AND FRENCH METHODS OF ASCERTAINING THE ILLUMINATING POWER OF COAL GAS. $1.60.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Kapp. $3.50.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $2.50.

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHTING, by Francis B. Crocker. $3.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRICITY, Its Theory, Sources and Applications. By John T. Sprague. $6.

The above will be forwarded upon receipt of price. If sent by mail or express, postage or express charges must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order. No books sent C.O.D.

A. M. CALLENDER & CO., 32 Pine Street, New York.

FRED. BREDEL, C.E.

Coal and Water Gas Plants.

OWN SYSTEM.

RECUPERATIVE FURNACES, WASHERS, CONDENSERS, PURIFIERS, PURIFYING MACHINES, COKE CONVEYERS, ETC.

SOLE UNITED STATES AGENT FOR

ARROL-FOULIS MECHANICAL CHARGING AND DRAWING MACHINES.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

GAS RETORTS AND SPECIAL BLOCKS AND FIREBRICK MANUFACTURED UNDER THE SUPERINTENDENCE OF MY OWN CHEMIST.

COMPLETE GAS WORKS

No. 118 Farwell Avenue, · Milwaukee, Wis.

Lloyd Construction Company,

76 HOME BANK BUILDING,

DETROIT, MICH.

MANUFACTURERS AND CONSTRUCTORS OF GAS APPARATUS AND PLANTS.

COAL GAS. Exhausting, Tar Extracting, Condensing, Scrubbing and Washing Apparatus.

WATER GAS. Lowe Double Superheater Apparatus, for all Capacities. Plain and Reverse Steam Connections.

PURIFIERS. Single and Double Depth, Center Seals or Valve Connections, Travelling Carriages, Oxide Conveyors.

Flanged and Street Specials, Gas Valves, Roofs, Iron Floors, etc., etc.

Complete Plants Erected.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,

238 Java Street, Brooklyn, N. Y.

GEORGE R. ROWLAND,

Formerly with the Continental Iron Works.

Draughtsman and Constructing Engineer.

Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.

Office, No. 245 Broadway, N. Y. City.

Coal Tar Genealogical Tree.

MR. T. VINER CLARKE, of London, England, having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

In the form of a Genealogical Tree, including all the products discovered to date, the total number amounting to near 700, offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, 3.50. Orders may be sent to

A. M. CALLENDER & CO.,
No. 32 Pine Street, New York City.

The Advertisement of the

P. H. & F. M. ROOTS CO., Mfrs. of Gas Exhausters, Blowers, etc.,

Connersville, Ind., = = = = 109 Liberty Street, New York City,

Occupies this Space Every Alternate Week.

Connelly Iron Sponge and Governor Co.,

395 Broadway, New York City.

TELEPHONE, 3033 Franklin. - - - CABLE ADDRESS, Governorco.

GEO. G. RAMSDELL, General Manager. S. F. HAYWARD, Treasurer.

MANUFACTURERS OF

CONNELLY

Automatic and Balance Governors,

Iron Sponge.

EASTERN AGENTS

P. H. & F. M. ROOTS CO.,

Exhausters and Exhauster Governors.

AGENTS FOR THE UNITED STATES,

JONAS DRAKE & SON

SYSTEM OF

Inclined Retorts.

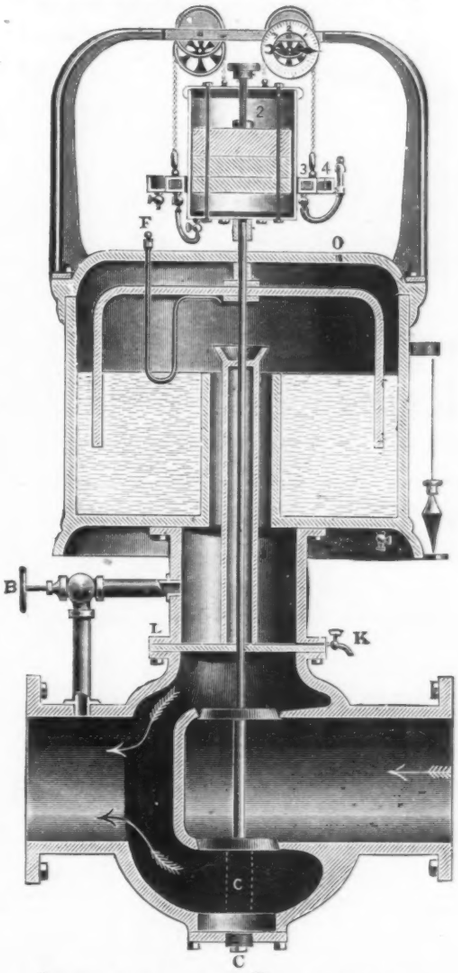
ZIMMER SWINGING CONVEYORS,

FOR HANDLING COAL OR COKE.

Jones Jet Photometer.

GAS SPECIALTIES.

CONNELLY'S



AUTOMATIC GOVERNOR.

MODEL OF 1900.

CONSTRUCTORS OF COAL GAS APPARATUS.

"GLOBE" SPECIALS, VALVES, ETC. "GLANORGAN" FIRE HYDRANTS

M. J. DRUMMOND & CO.

MANUFACTURERS OF CAST IRON FLANGE GAS AND WATER PIPE

GENERAL SALES OFFICE, 192 BROADWAY, NEW YORK.

GEORGE ORMROD, Mangr. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA.

CAST IRON GAS & WATER PIPE

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

Send for Circulars.

Geo. Light,

DAYTON, O.

Hughes' "GAS WORKS,"

Their Construction and Arrangement,

And the Manufacture and Distribution of Coal Gas.

Originally written by SAM'L HUGHES, C.E.
Rewritten and Much Enlarged by
WM. RICHARDS, C.E.

Eighth Edition, Revised, with Notices of Recent Improvements.

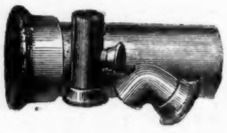
Price, $1.65.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.



CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

CHARLES MILLAR & SON CO., Selling Agents, Utica, N.Y.

Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, Jute, etc.

UTICA PIPE FOUNDRY CO.

Manufacturers of Lead Pipe, Solder, etc., and Jobbers of Plumbers' and Tinners' Goods.

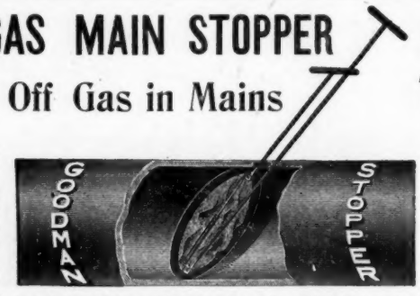
CAST IRON PIPE and SPECIALS FOR WATER AND GAS

Wholesale Eastern Agents AKRON VITRIFIED SEWER PIPE.

SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains

Any size gas main can be shut off in 30 seconds. : : :



Temporarily during alterations and repairs. : : : :

STOPPERS SENT ON TRIAL.

Address: SAFETY GAS MAIN STOPPER CO., 108 E. 117th St., New York City.

Parson's Steam Blower

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER,

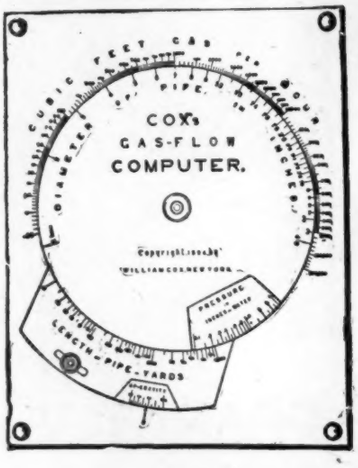
FOR USING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER,

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial.* No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

H. E. PARSON, Supt., 457 Putnam Ave., Brooklyn, N. Y.



Do you wish to Know

what size of Pipe to use to convey any quantity of Gas, any distance, with any loss of pressure, and any initial or final pressure? Then use

COX'S GAS FLOW COMPUTER,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50.

For sale by

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.

(Copyrighted, 1894, by the AMERICAN METER CO.)

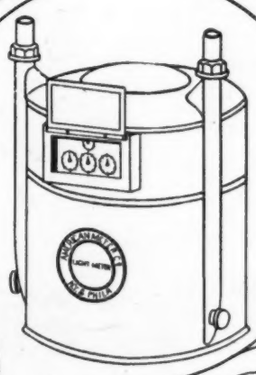
AMERICAN METER CO.

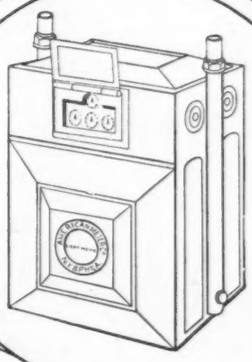
ESTABLISHED 1834. INCORPORATED 1863.

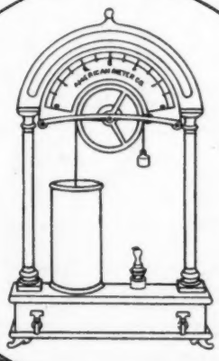
NEW YORK AND PHILADELPHIA,

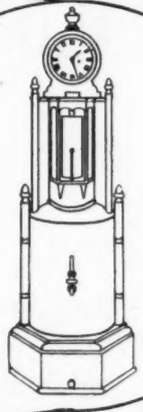
CHICAGO, ST. LOUIS,

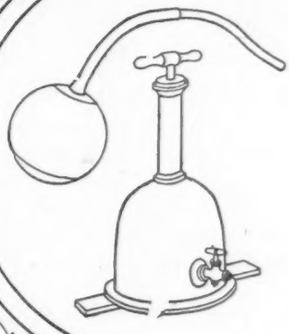
SAN FRANCISCO.

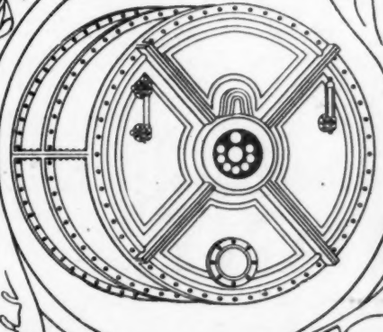


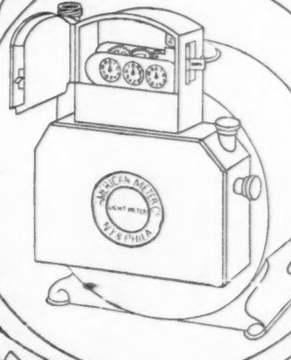












PUBLIC LIGHTING TABLE.

APRIL, 1902.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	6.50 PM	2.50 AM	6.10	4.55
Wed.	2	6.50	3.30	6.15	4.40
Thu.	3	6.50	4.10	6.15	4.40
Fri.	4	6.50	4.40	6.15	4.40
Sat.	5	6.50	4.40	6.15	4.40
Sun.	6	7.00	4.30	6.15	4.40
Mon.	7	7.00	4.30	6.15	4.40
Tue.	8	7.00 NM	4.30	6.15	4.40
Wed.	9	7.00	4.20	6.25	4.30
Thu.	10	7.00	4.30	6.25	4.30
Fri.	11	7.00	4.30	6.25	4.30
Sat.	12	7.00	4.30	6.25	4.30
Sun.	13	11.20	4.20	6.25	4.30
Mon.	14	12.10 AM 2Q	4.20	6.25	4.30
Tue.	15	12.50	4.20	6.25	4.30
Wed.	16	1.30	4.20	6.30	4.20
Thu.	17	2.00	4.20	6.30	4.20
Fri.	18	2.30	4.20	6.30	4.20
Sat.	19	3.00	4.20	6.30	4.20
Sun.	20	3.30	4.20	6.30	4.20
Mon.	21	No L.	No L.	6.30	4.20
Tue.	22	No L. FM	No L.	6.30	4.20
Wed.	23	No L.	No L.	6.40	4.10
Thu.	24	7.20 PM	9.40 PM	6.40	4.10
Fri.	25	7.20	10.30	6.40	4.10
Sat.	26	7.20	11.20	6.40	4.10
Sun.	27	7.20	12.10 AM	6.40	4.10
Mon.	28	7.20	12.50	6.40	4.10
Tue.	29	7.20	1.30	6.40	4.10
Wed.	30	7.20 LQ	2.00	6.45	4.00

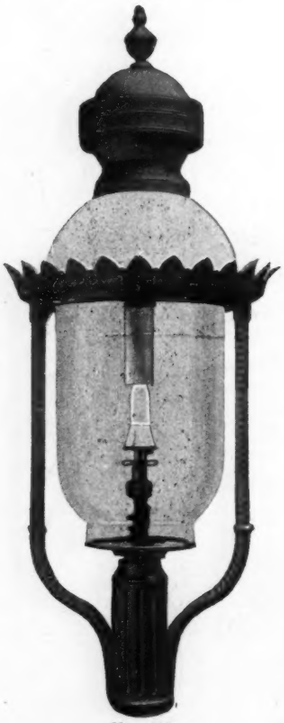
TOTAL HOURS LIGHTING DURING 1902.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	238.30	January	423.20
February	196.20	February	355.25
March	196.20	March	355.35
April	166.40	April	298.50
May	151.40	May	264.50
June	131.10	June	234.25
July	142.40	July	243.45
August	162.00	August	280.25
September	179.00	September	321.15
October	216.30	October	374.30
November	224.10	November	401.40
December	250.00	December	433.45
Total, yr.	2255.00	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

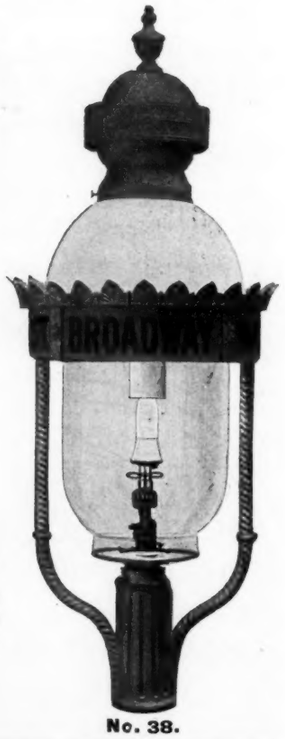
POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and Outside Lighting.



No. 38.

UNIVERSAL WELSBACH BURNER.

The most practical, efficient and artistic burner yet produced. . . . . .

It contains an improved adjustable Bunsen so constructed as to permit of a wide range of variations in gas pressure without blackening the mantles and without an adjustable air shutter. . .

It can be used with all styles and sizes of glassware, either shades or globes. No further necessity to carry a stock of different burners for the many sizes and shapes of glassware.

GAS COMPANIES AND DEALERS CANNOT FAIL TO APPRECIATE THE MANY SALABLE FEATURES OF THIS NEW BURNER.

WELSBACH COMPANY,

GLOUCESTER, N. J. CHICAGO, ILLS.

Salesrooms in all the Leading Cities of the United States.

THE STANDARD DOUBLE SUPERHEATER

LOWE WATER GAS APPARATUS.

The capacity of apparatus installed, if operated continuously, is sufficient to make more than the entire amount of artificial gas annually sold in the United States.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY Prest. DAVID R. DALY V. Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

A. H. GUTKES, President. E. L. RICE, Vice-President. H. A. PERKINS, Secretary.

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.

Office, 88 Van Dyke St. Brooklyn, N. Y.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of GAS RETORTS . . FIRE BRICK . . . RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office: 914, 915 & 916 Wainwright Building, St. Louis, Mo.

S. D. MERTON. F. R. SELLMAN.

S. D. MERTON & CO.,
CONTRACTORS AND FURNACE BUILDERS,
ST. LOUIS.

WE DESIGN AND BUILD
HIGH GRADE BENCHES.

Adam Weber Sons.

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Main Office, Park Row Building, New York.

Modern Recuperative Furnaces.

Standard Fire Brick and Gas Retorts.

Designers and Builders of Chimneys of Perforated ..Radial Blocks..

ISAAC C. BAXTER, President. —ESTABLISHED 1864.— PETER YOUNG, Sec'y and Treas.

Works, LOCKPORT STATION, PA.

JAMES GARDNER, JR., CO.,

Address all communications to JAMES GARDNER, JR., CO., Box 277, JOHNSTOWN, PA.

Successor to WILLIAM GARDNER & SON,

Fire Clay Goods for Gas Works.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,
417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO.

MANUFACTORY AT
LOCUST POINT, BALTIMORE, MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT.

Our Improved Half and Full Depth Benches have been Adopted by Many Gas Companies.

WALDO BROS., 102 MILK ST., BOSTON, MASS.
Sole Agents for New England States.

JOHN DELL,
President and General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

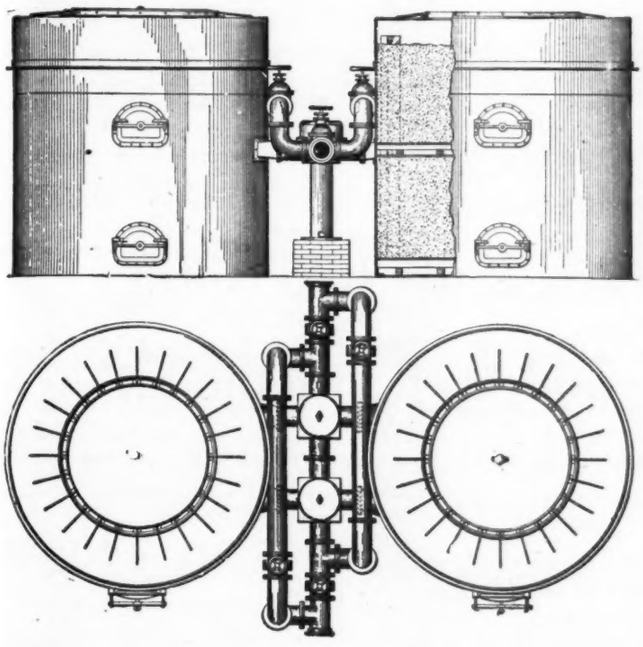
MANUFACTURERS OF

Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are the **Exclusive Agents** *for the* **Mitchell Patent Benches,** *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or* **Rear Clinkering.** **The Mitchell** *is the* **Original Coal Firing Bench.** *We also Erect Plain Benches with* **One** *to* **Six Retorts.**

YOUR CORRESPONDENCE IS RESPECTFULLY SOLICITED.

City Office: *411 Olive Street, Continental Bank,* ST. LOUIS, MO.



Chollar's System of Gas Purification.

THE PURIFIED GAS REVIVES THE FOULED OXIDE.

Patented in UNITED STATES, CANADA, GREAT BRITAIN, FRANCE, BELGIUM, GERMANY, AUSTRIA AND HUNGARY.

NOTICE TO GAS COMPANIES!

The unauthorized use of any system or method of purification, whereby gas mingled with oxygen is made to flow in one general direction through the purifying mass, and then made to flow through the mass in a directly opposite direction, infringes the above patents!

For Estimates Write

The Stacey Mfg. Co.,

SOLE MANUFACTURERS,

CINCINNATI, O.

Newbigging's Handbook for Gas Engineers and Managers,

By THOMAS NEWBIGGING, M.Inst.C.E.

Price, $6. For Sale by

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.

QUINTARD IRON WORKS,

N. F. PALMER,

Foot of 12th St. & East River, New York,

MANUFACTURERS OF

GAS APPARATUS.

Complete Works Erected.

FREDERICK W. FLOYD, Engineer.

THE ECONOMICAL GAS APPARATUS CONSTRUCTION COMPANY, LIMITED,

Engineers and Builders of water and coal gas apparatuses and general gas works machinery. : : :

AMERICAN OFFICES:
269 Front Street, East Toronto, Ont.

LONDON OFFICES:
19 Abingdon St., Westminster, S. W.

CABLE ADDRESS:
"CARBURETED" LONDON AND TORONTO.

ELECTRIC GAS LIGHTING.

HOW TO INSTALL ELECTRIC GAS IGNITING APPARATUS, INCLUDING THE JUMP SPARK AND MULTIPLE SYSTEMS FOR USE IN HOUSES, CHURCHES, THEATERS, HALLS, SCHOOLS, STORES OR ANY LARGE BUILDING. ALSO, THE CARE AND SELECTION OF SUITABLE BATTERIES, WIRING AND REPAIRS.

By H. S. NORRIE.

Price, . . 50 Cents. Orders may be sent to

A. M. CALLENDER & CO., 32 Pine St., New York City.

PRACTICAL HANDBOOK ON

GAS ENGINES,

With Instructions for Care and Working of the Same.

By G. LIECKFELD, C.E.

Translated with Permission of the Author, by GEO. M. RICHMOND, M.E.

PRICE, $1.00.

A. M. CALLENDER & CO., 32 Pine Street, New York City.

JAMES D. PERKINS, President. F. SEAVERNS, Treasurer.

THE PERKINS COMPANY,

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal,
Old Kentucky Shale and O. K. Boghead.

SHIPMENTS FROM NEW YORK, PHILADELPHIA, BALTIMORE AND NORFOLK

BERWIND-WHITE COAL MINING COMPANY'S

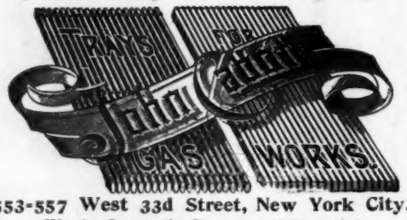
Ocean Westmoreland Gas Coal.

Offices:
Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
Heavy Steaming.

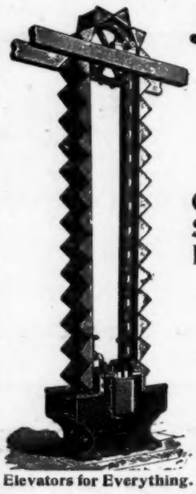
Church's Patent Trays.

Reversible; Strongest; Most Easily Repaired.
Special Trays for Iron Sponge.



553-557 West 33d Street, New York City.
We also Supply the Cheapest and Strongest
•Reversible Bolted Trays•
IN THE MARKET.
SEND FOR CIRCULARS.

Bristol's Recording
PRESSURE GAUGE.
For continuous records of
Street Gas Pressure
Simple in construction, accurate in operation and low in price.
Fully Guaranteed. Send for Circulars.
THE BRISTOL CO.,
Waterbury, Conn.
Silver Medal, Paris Exposition.

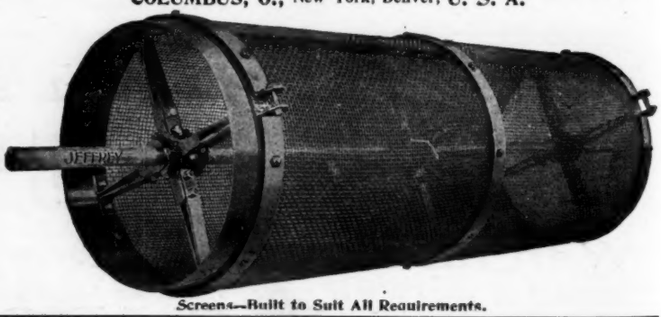


Elevators for Everything.

JEFFREY
ELEVATING MACHINERY
FOR HANDLING
COAL, COKE, ETC.

COKE CRUSHERS.
SHAKING SCREENS.
POWER TRANSMISSION MACHINERY.

FOR CATALOGUE, ADDRESS
THE JEFFREY MANUFACTURING CO.,
COLUMBUS, O., New York, Denver, U. S. A.



Screens—Built to Suit All Requirements.

The Gas Engineer's Laboratory Handbook.

By JOHN HORNBY, F.I.C. Price, $2.50.
Orders may be sent to
A. M. CALLENDER & CO., 32 Pine St., N. Y.

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

Do You Wish to Know

what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

Cox's Gas Flow Computer,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50. For sale by

A. M. Callender & Co., 32 Pine St., N. Y.

POOLE ON FUELS.

THE CALORIFIC POWER OF FUELS.

By HERMAN POOLE, F.C.S.

Second Edition. Price, $3. For Sale by

A. M. CALLENDER & CO., 32 PINE ST., N.Y. CITY.

BINDER for the JOURNAL.

Price, $1.00.

A. M. CALLENDER & CO., 32 Pine Street, N.Y.

EDMUND H. McCULLOUGH, President. CHAS. F. GODSHALL, Treasurer. H. C. ADAMS, Secretary. HENRY WHARTON, Assistant Secretary.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

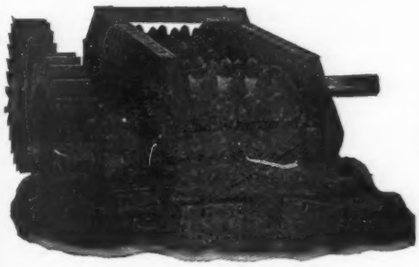
PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J., WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE LINK-BELT MACHINERY CO.,

ENGINEERS, FOUNDERS, MACHINISTS,
Chicago, U. S. A.



"Link-Belt" Breaker.

Tilting Coal and Coke Cars, Breaker Rolls, Power Transmitting Machinery.

LINK-BELT ELEVATING & CONVEYING MACHINERY for HANDLING COAL, COKE, OXIDE, ETC.

Machinery designed and erected to suit existing conditions and available space.

CATALOGUE UPON APPLICATION.

PHILADELPHIA, LINK-BELT ENGINEERING CO.

THE SUN OIL CO.

Crude Oil, Gas Naphtha,
Refined Petroleum, Gas Oil.

Toledo, O., and Pittsburgh, Pa.

Coal Tar Genealogical Tree

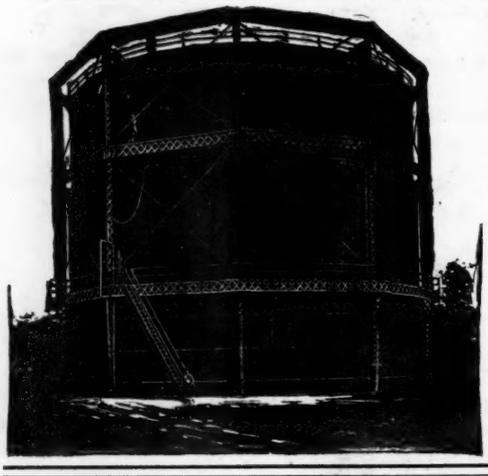
MR. T. VINER CLARKE, of London, Eng.,

Having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

in the form of a Genealogical Tree, including all the products discovered to date (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.



DAVIS & FARNUM MFG. CO.,

WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

BAXTER & YOUNG,

CONTRACTING AND CONSULTING GAS ENGINEERS.

Examination and Values Ascertained of Artificial and Natural Gas Properties.

COMPLETE GAS WORKS ERECTED.

Artificial and Natural Gas Mains Furnished and Laid.

GAS PROPERTIES PURCHASED.

OFFICE: WAYNE COUNTY BANK BUILDING,
Rooms 201 & 202. DETROIT, MICH.

A. E. BOARDMAN, C. E.,

Consulting and Contracting Engineer.

Particular attention given to Gas, Water and Electric Plants. Long and successful experience with the problem and practice of

Filtration for Public Water Supply.

BREVARD, N. C.

JAMES T. LYNN,

GAS ENGINEER AND CONTRACTOR,

Wayne Bank Building, - DETROIT

GAS PROPERTIES PURCHASED.

Geo. Shepard Page's Sons.

GAS MACHINERY.

Correspondence Solicited.

180 Fulton Street, New York City.

DAVID LEAVITT HOUGH,

Consulting Engineer AND CONTRACTOR,

374 FIFTH AVE., N. Y.

KERR MURRAY MANUFACTURING CO.

Latest Design Rotary Exhauster, With Automatic Governor,

Single or Double-Lift Gasholders,

WITH OR WITHOUT STEEL TANKS.

Storage Oil Tanks, Condensers and Scrubbers.

Purifying Boxes, with Cover-Lifting Apparatus, Center Seal or Valve System Connections and Oxide Elevator.

REVERSIBLE WOOD PURIFYING AND SCRUBBING TRAYS.

Mouthpieces, Standpipes, Etc.; in Fact, All Classes of Ironwork for Benches.

DOUBLE GATE ALL IRON GAS VALVES, 3 TO 36 INCHES DIAMETER.

ALL SIZES OF STREET SPECIAL CASTINGS.

FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double and Single-Lift Gasholders.

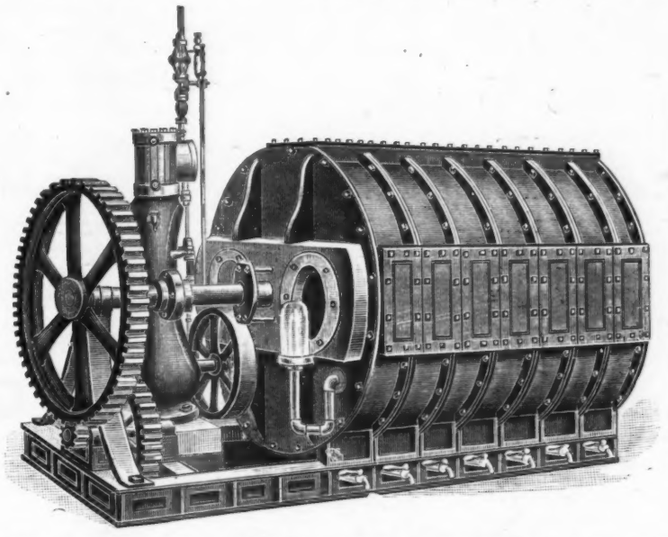
Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS

PURIFIERS.



CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS.

Boilers.

PATENT STANDARD WASHER-SCRUBBER.

The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Discs, thus reducing the weight on shaft and power for operating same.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

The Gas Engineer's Pocket-Book,

By HENRY O'CONNOR.

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

PRICE, $3.50.

A. M. CALLENDER & CO., 32 Pine Street, New York City.

ALEX. C. HUMPHREYS, M.E., M. Inst. C.E. ARTHUR G. GLASGOW, M.E., M. Inst. C.E.

HUMPHREYS & GLASGOW,

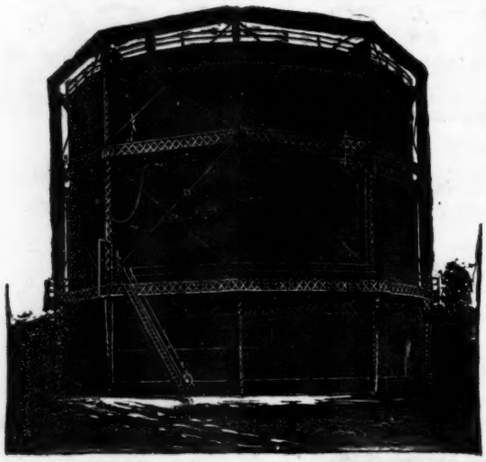
BANK OF COMMERCE BLDG., 31 Nassau Street, New York.

38 VICTORIA STREET, London S.W., England.

CONSULTING GAS AND ELECTRIC LIGHT ENGINEERS.

PROPERTIES PURCHASED.

COMPLETE EXAMINATIONS MADE.



DAVIS & FARNUM MFG. CO.,

WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

BAXTER & YOUNG,

CONTRACTING AND CONSULTING GAS ENGINEERS.

Examination and Values Ascertained of Artificial and Natural Gas Properties.

COMPLETE GAS WORKS ERECTED.

Artificial and Natural Gas Mains Furnished and Laid.

GAS PROPERTIES PURCHASED.

OFFICE: WAYNE COUNTY BANK BUILDING,

Rooms 201 & 202. DETROIT, MICH.

A. E. BOARDMAN, C. E.,

Consulting and Contracting Engineer.

Particular attention given to Gas, Water and Electric Plants. Long and successful experience with the problem and practice of

Filtration for Public Water Supply.

BREVARD, N. C.

Geo. Shepard Page's Sons.

GAS MACHINERY.

Correspondence Solicited.

180 Fulton Street, New York City.

JAMES T. LYNN,

GAS ENGINEER AND CONTRACTOR,

Wayne Bank Building, - DETROIT

GAS PROPERTIES PURCHASED.

DAVID LEAVITT HOUGH,

Consulting Engineer AND **CONTRACTOR,**

374 FIFTH AVE., N. Y.

KERR MURRAY MANUFACTURING CO.

Latest Design Rotary Exhauster, With Automatic Governor,

Single or Double-Lift Gasholders,

WITH OR WITHOUT STEEL TANKS.

Storage Oil Tanks, Condensers and Scrubbers.

Purifying Boxes, with Cover-Lifting Apparatus, Center Seal or Valve System Connections and Oxide Elevator.

REVERSIBLE WOOD PURIFYING AND SCRUBBING TRAYS.

Mouthpieces, Standpipes, Etc.; in Fact, All Classes of Ironwork for Benches.

DOUBLE GATE ALL IRON GAS VALVES, 3 TO 36 INCHES DIAMETER.

ALL SIZES OF STREET SPECIAL CASTINGS.

FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double and Single-Lift Gasholders.

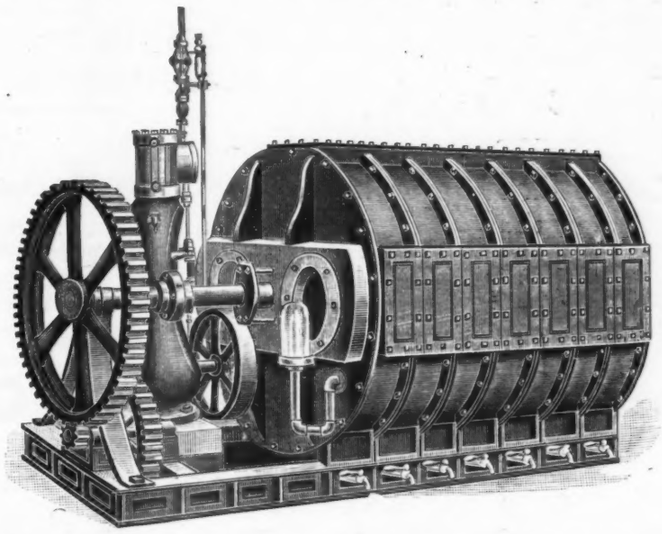
Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS

PURIFIERS.



CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS.

Boilers.

PATENT STANDARD WASHER-SCRUBBER.

The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Discs, thus reducing the weight on shaft and power for operating same.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

The Gas Engineer's Pocket-Book,

By HENRY O'CONNOR.

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

PRICE, $3.50.

A. M. CALLENDER & CO., 32 Pine Street, New York City.

ALEX. C. HUMPHREYS, M.E., M. Inst. C.E. ARTHUR G. GLASGOW, M.E., M. Inst. C.E.

HUMPHREYS & GLASGOW,

BANK OF COMMERCE BLDG., 31 Nassau Street, New York.

38 VICTORIA STREET, London S.W., England.

CONSULTING GAS AND ELECTRIC LIGHT ENGINEERS.

PROPERTIES PURCHASED.

COMPLETE EXAMINATIONS MADE.

R. D. WOOD & CO.,

400 CHESTNUT ST., PHILADELPHIA,

MANUFACTURERS OF

Cast Iron Pipe.

HEAVY LOAM CASTINGS,

Dunham Specials,

Hydraulic Work,

LAMP POSTS, VALVES, ETC.,

Gas Power Plants with Producers.

BUILDERS OF

Gasholders.

Single, Double and Triple Lifts, with or without Metal Tanks.

PURIFIERS, CONDENSERS, SCRUBBERS, BENCH WORK.

Cutler's Patent Freezing Preventer for Holder Cups.

ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

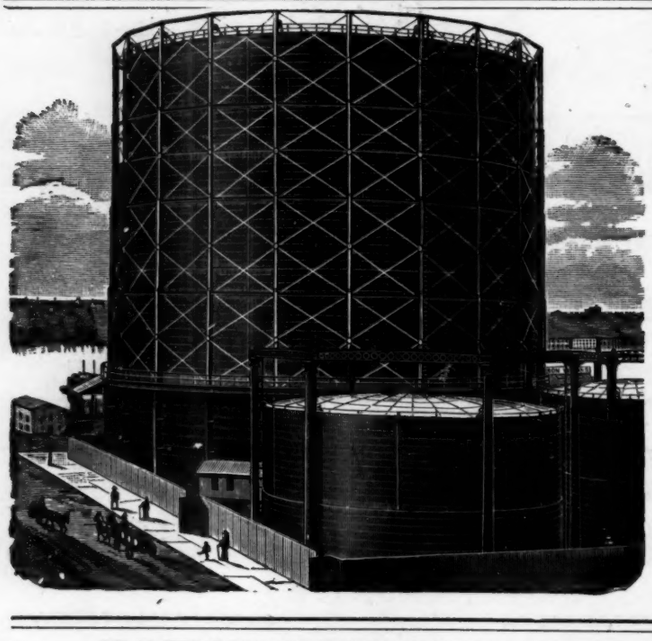
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. —OFFICES— **Bridge & Ogden Sts., Newark, N. J.**



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

West and Calyer Sts. (Near 10th & 23d St. Ferries)
NEW YORK, Borough of Brooklyn.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

STEEL GAS HOLDER TANKS.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

BURDETT LOOMIS, - - Hartford, Conn.

The Gas Engineer's Laboratory Handbook,

By JOHN HORNBY, F.I.C.

Price, $2.50.

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.

THE STACEY MANUFACTURING CO.,

CONTRACTORS FOR THE ERECTION OF COMPLETE WORKS.

GAS WORKS APPARATUS.

GASHOLDERS

WITH AND WITHOUT

STEEL TANKS.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT AND CAST IRON WORK.

EASTERN OFFICE:
1051 & 1052 Drexel Building,
Philadelphia, Pa.

GENERAL OFFICES:
CINCINNATI, O.
TELEPHONE, West 690.

RITER-CONLEY MFG. CO.,

GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks.

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

GENERAL OFFICE: Pittsburg, Pa. EASTERN OFFICE: 39-41 Cortlandt St., New York City.

WM. HENRY WHITE,

No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

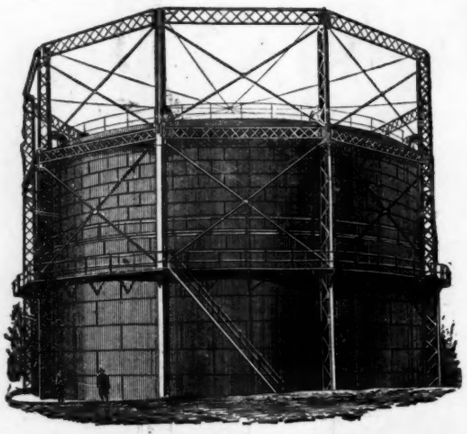
Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited.
Plans and Estimates Furnished.

1901 DIRECTORY 1901

OF AMERICAN GAS COMPANIES.

Price, - - - - - - - - - $5.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.



1842 ※ Deily & Fowler, ※ 1902

LAUREL IRON WORKS.

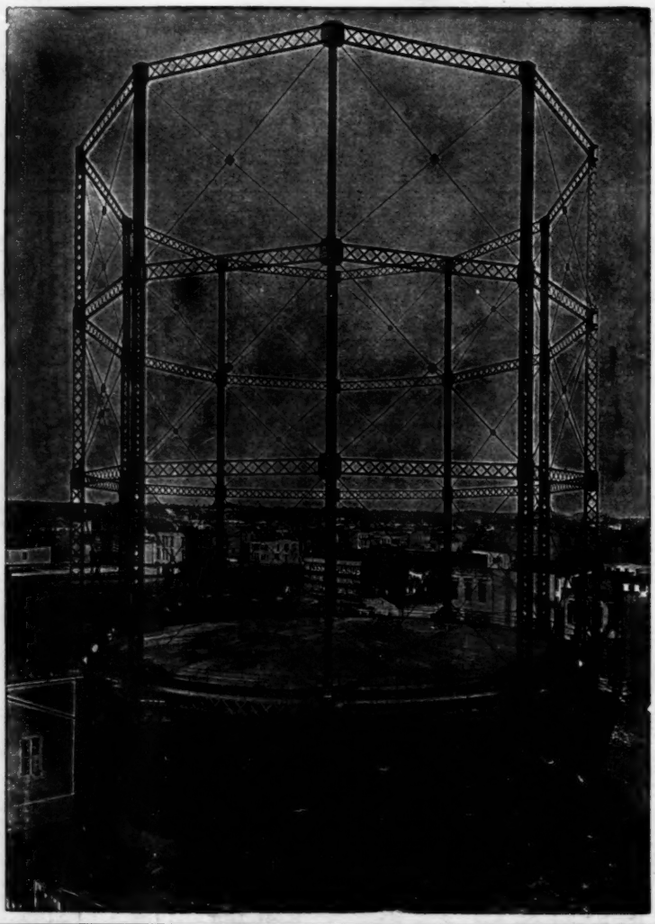
Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.



The order for this Triple-Lift Holder and Steel Tank was received by the Logan Iron Works from the Union Gas Light Company, of East New York. The contract was completed and the Holder was in actual use in 90 days from receipt of order. Capacity of Holder, 500,000 Cu. Ft.

LOGAN IRON WORKS,

Brooklyn, N. Y.

MANUFACTURERS OF

Single or Multiple-Lift

GASHOLDERS,

Complete with Steel Tanks.

BENCHES, SCRUBBERS,
CONDENSERS,
PURIFIERS, IRON ROOFS,
Self-Sealing Retort Lids,
AND ALL PARTS OF
GAS WORKS APPARATUS.

Contractors for
Complete Works.

ALSO, SOLE MANUFACTURERS OF

C. W. BLODGET'S
HOT GAS SCRUBBER.

PRACTICAL PHOTOMETRY,

A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations. Price, $3.00.

A. M. CALLENDER & CO., 32 Pine Street, New York City.

Established 1854.

D. McDONALD & CO.,

MANUFACTURERS OF

WET AND DRY METERS, STATION METERS AND METER PROVERS.

ALSO MAKERS OF

THE GLOVER PREPAYMENT METER.

The amount of gas delivered for the coin can be instantly and positively changed without removing the meter or replacing any parts.

The gas registered agrees absolutely with the amount purchased by the coin.

WE HAVE MADE AND SOLD IN THE UNITED STATES

OVER 70,000 OF THESE METERS,

ALL OF WHICH ARE GIVING PERFECT SATISFACTION.

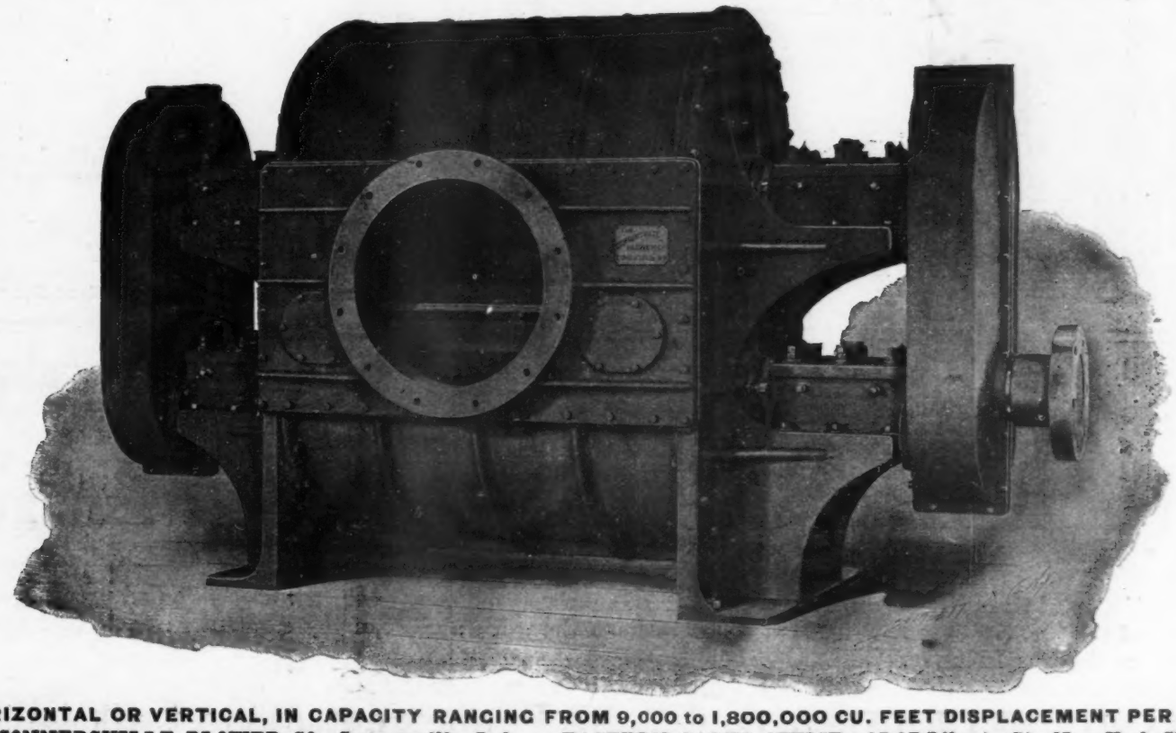
Correspondence Solicited.

561 West Forty-seventh Street, NEW YORK. | 51, 53 & 55 Lancaster Street, ALBANY, N. Y. | 34 & 36 West Monroe Street, CHICACO.

THE CONNERSVILLE BLOWER CO.,

MANUFACTURER OF

ROTARY POSITIVE PRESSURE GAS EXHAUSTERS, BLOWERS AND PUMPS.



HORIZONTAL OR VERTICAL, IN CAPACITY RANGING FROM 9,000 to 1,800,000 CU. FEET DISPLACEMENT PER HOUR.

CONNERSVILLE BLOWER CO., Connersville, Ind. EASTERN SALES OFFICE: 95-97 Liberty St., New York City.

Established 1849. With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS METER CO.,

8 Medford Street, Boston, Mass.

MANUFACTURERS OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Prepayment Gas Meters.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 88 to 92 West, Jackson Boulevard.**

SAN FRANCISCO, 221 Front St.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Perfect" Gas Stoves.

THE KEYSTONE PREPAYMENT

IS

An Accurate Registrar,
A Sure Shut-off,
An Ideal for Easy Adjustment,
A Model of Simplicity,
A Paragon of Excellence, and
A Mighty Good All-round Meter. Get Acquainted with it.

Keystone Meter Co., ROYERSFORD, PA.

WIESTER & CO., 22 Second Street, San Francisco, Cal.

NOW READY.

THE SIXTH (AND CENTENARY) EDITION

— OF THE —

Handbook for Gas Engineers and Managers.

By THOMAS NEWBIGGING, M. Inst. C.E.

This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions. Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry.

PRICE, - - $6.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, N. Y. City.

AMERICAN METER COMPANY,

NEW YORK, PHILADELPHIA, SAN FRANCISCO.

PREPAYMENT METERS.

THEIR CONSTRUCTION IS SUCH THAT THEY MAY BE READILY READJUSTED WHEN THE SCALE OF GAS RATES IS CHANGED.

HELME & McILHENNY,

Established 1848. 1339 to 1349 Cherry Street, Philadelphia, Pa.

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED.

METRIC METAL COMPANY.

MAKERS OF

GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

This is the best time to look after your repairing.

Seventy per cent. of old meters run slow. You are losing money on them. Let us put them in shape for you, a few at a time, until your entire meter equipment is made as good as new. It is better to attend to this matter now, before the Gas Stove season is at its height. Probably we can do such work in our factory better and cheaper than you can do it at home, and just now we can do it promptly.

The BUHL METERS are as good Meters as you can get.

DETROIT METER COMPANY, - - Detroit, Mich.

Advertisement of

JOHN J. GRIFFIN & CO., Mfrs. of Gas Meters, etc.,

Nos. 1513, 1515, 1517, 1519 & 1521 Race Street, Philadelphia,

559 West 47th Street, New York, 34 West Monroe Street, Chicago,

Occupies this Space Every Alternate Week.

THE WESTERN GAS CONSTRUCTION COMPANY,

Gas Engineers & Builders.

IMPROVED LOWE WATER GAS APPARATUS.

IMPROVED COAL GAS APPARATUS.

Contractors for the Construction of Complete New Works and the Reconstruction of Old to Increased Capacity and Efficiency. Special Apparatus, Valves and Fittings.

Fort Wayne, Indiana.